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ATTORNEY DOCKET NO. 10030899-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): R. Shane Fazio

Serial No.: 10/807,417 Examiner: Monica Lewis

Filing Date: March 23, 2004 Group Art Unit: 3854

Title: Microcap Wafer Bonding Apparatus

COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on October 20, 2008 .

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) **$500.00**.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

☐ (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)(1)-(5)) for the total number of months checked below:

☐	one month	$ 120.00
☐	two months	$ 450.00
☐	three months	$1020.00
☐	four months	$1590.00

☐ The extension fee has already been filled in this application.

☒ (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **50-3718** the sum of $500.00 . At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account **50-3718** pursuant to 37 CFR 1.25.

Respectfully submitted,

R. Shane Fazio

By _____

Thomas F. Woods
Attorney/Agent for Applicant(s)

Reg. No. 36,726

Date: October 23, 2008

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: R. Shane Fazzio

Examiner Name: Monica Lewis

Serial No.: 10/807,417

Group Art Unit: 2822

Filed: March 23, 2004

Attorney Docket No.: 10030899-1

Confirmation No.: 3854

Title: Microcap Wafer Bonding Apparatus

APPEAL BRIEF

Mail Stop Appeal Brief -- Patents
Commissioner for Patents
P.O. Box 1450
Arlington, VA 22313-1450

Sir:

In response to a Final Office Action dated July 18, 2008, wherein claims 24-27 and 31-36 were finally rejected, and further to the Notice of Appeal filed October 20, 2008, Applicants respectfully request entry of this Appeal Brief, and allowance of the presently pending but finally rejected claims in the above-identified patent application.

DATE OF DEPOSIT: October 23, 2008

CERTIFICATE OF ELECTRONIC DEPOSIT: I hereby certify that all paper(s) described herein are being filed electronically with the United States Patent and Trademark Office on the date indicated above and addressed to Mail Stop Appeal Brief - Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signature: 

Printed Name: Thomas F. Woods, Reg. No. 36,726

I. Real Party in Interest

The Real Party in Interest of the above-referenced patent application is Avago Technologies Wireless IP (Singapore) PTE. Ltd.

II. Related Appeals and Interferences

There are no related appeals or interferences respecting the above-referenced patent application.

III. Status of the Claims

Claims 24-27 and 31-36 remain pending in the present patent application. Claims 24-27 and 31-36 are the subject of this appeal, claims 1-23 and 28-30 having been cancelled previously. The particular status of each claim is as follows:

Claim 1: Cancelled and *not* appealed herein.
Claim 2: Cancelled and *not* appealed herein.
Claim 3: Cancelled and *not* appealed herein.
Claim 4: Cancelled and *not* appealed herein.
Claim 5: Cancelled and *not* appealed herein.
Claim 6: Cancelled and *not* appealed herein.
Claim 7: Cancelled and *not* appealed herein.
Claim 8: Cancelled and *not* appealed herein.
Claim 9: Cancelled and *not* appealed herein.
Claim 10: Cancelled and *not* appealed herein.
Claim 11: Cancelled and *not* appealed herein.
Claim 12: Cancelled and *not* appealed herein.
Claim 13: Cancelled and *not* appealed herein.
Claim 14: Cancelled and *not* appealed herein.
Claim 15: Cancelled and *not* appealed herein.
Claim 16: Cancelled and *not* appealed herein.
Claim 17: Cancelled and *not* appealed herein.
Claim 18: Cancelled and *not* appealed herein.
Claim 19: Cancelled and *not* appealed herein.
Claim 20: Cancelled and *not* appealed herein.
Claim 21: Cancelled and *not* appealed herein.
Claim 22: Cancelled and *not* appealed herein.
Claim 23: Cancelled and *not* appealed herein.

Claim 24: Rejected and appealed herein.

Claim 25: Rejected and appealed herein.

Claim 26: Rejected and appealed herein.

Claim 27: Rejected and appealed herein.

Claim 28: Cancelled and *not* appealed herein.

Claim 29: Cancelled and *not* appealed herein.

Claim 30: Cancelled and *not* appealed herein.

Claim 31: Rejected and appealed herein.

Claim 32: Rejected and appealed herein.

Claim 33: Rejected and appealed herein.

Claim 34: Rejected and appealed herein.

Claim 35: Rejected and appealed herein.

Claim 36: Rejected and appealed herein.

Claims that are the subject of this Appeal are presented in the Claim Appendix hereto in their present form.

IV. Status of Amendments

Various amendments to claim 24 have been made and presumably entered in the present application as described in detail below.

Claims 24-27 and 31-36 were first presented in the present patent application in an RCE and Preliminary Amendment and Response filed August 27, 2007, where such claims were presented as "new" claims. Thereafter, only claim 24 was amended in a Response and Amendment filed April 21, 2008. In a Final Office Action dated July 18, 2008, the Examiner did not explicitly state that the amendments requested to claim 24 in the April 21, 2008 paper filed by applicant's attorney had been entered, neither did such Final Office Action indicate that such amendments had not been entered. In addition, in the Final Office Action mailed July 18, 2008, the Examiner acted on and made substantive arguments in rejecting claim 24 as it was amended in the April 21, 2008 paper, and accordingly applicant's attorney must presume the amendments requested in the April 21, 2008 paper were duly entered by the Examiner.

Amendments to Figures 1 and 2 filed June 1, 2006 were explicitly acknowledged by the Examiner as having been entered in the Final Office Action dated July 18, 2008.

Other than the amendments described hereinabove, no other amendments to the specification, drawings or still-pending claims have been made during the prosecution of this patent application.

V. Summary of the Claimed Subject Matter

Some products use packaging technology that involves bonding a cap over a predetermined area of a substrate to create a hermetically sealed cavity. The hermetically sealed cavity is often formed to protect sensitive circuit elements therein. Figure 1 is a perspective illustration of a sample apparatus 10 including a device chip 20 having a substrate 22 and circuit elements 24 fabricated on the substrate 22. A cap 30 is attached, via thermo compression bond, over the device chip 20 defining a hermetically sealed cavity within which the circuit elements 24 are protected.

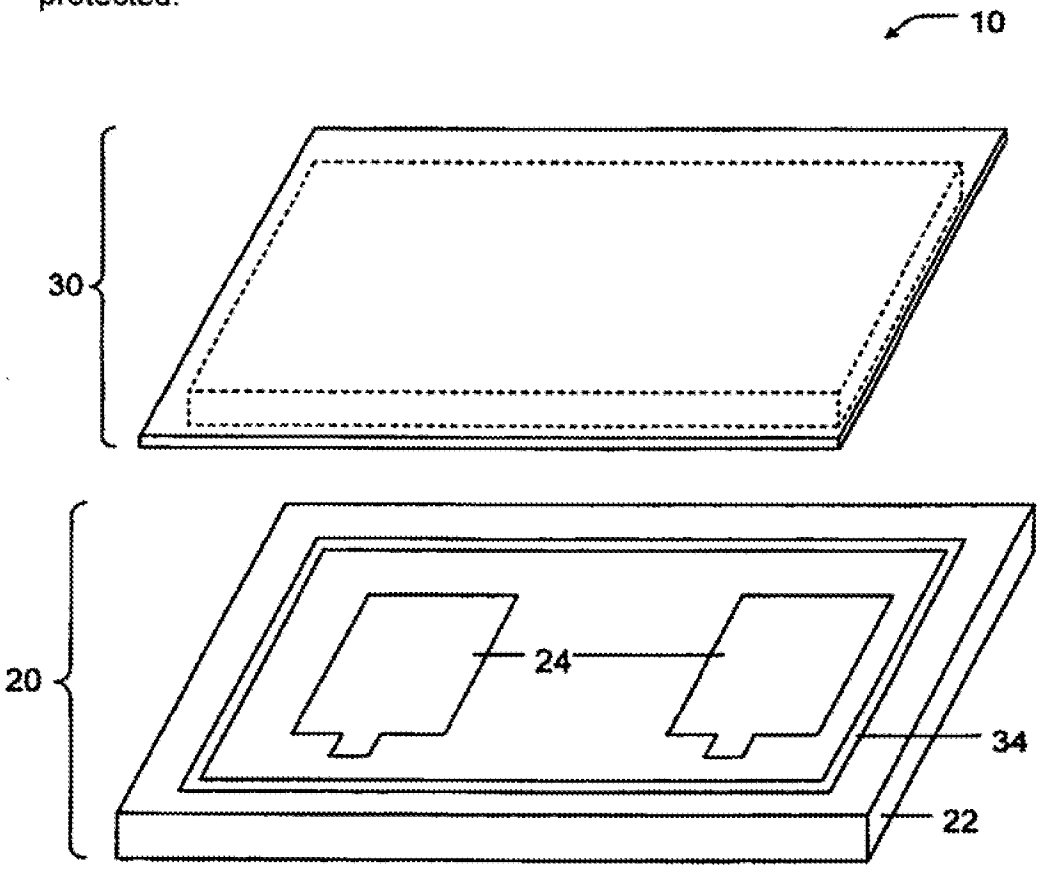


FIG. 1 (Prior art)

Fig. 1 of the Present Patent Application

Figure 2 illustrates a cut-away side view of the apparatus 10 of Figure 1 after the bonding process. The hermetically sealed cavity is indicted with reference number 26. As illustrated, bottom of the hermetically sealed cavity 26 is defined by the device chip 20 including the substrate 22 and the circuit elements 24. Top of the hermetically sealed cavity 26 is defined by the cap 30. The sizes of the device chip 20 and the cap 30 can vary greatly depending on implementation but can be, for example, on the order of millimeters (mm) or fractions of millimeters, for example, about 0.5 mm to 2 mm.

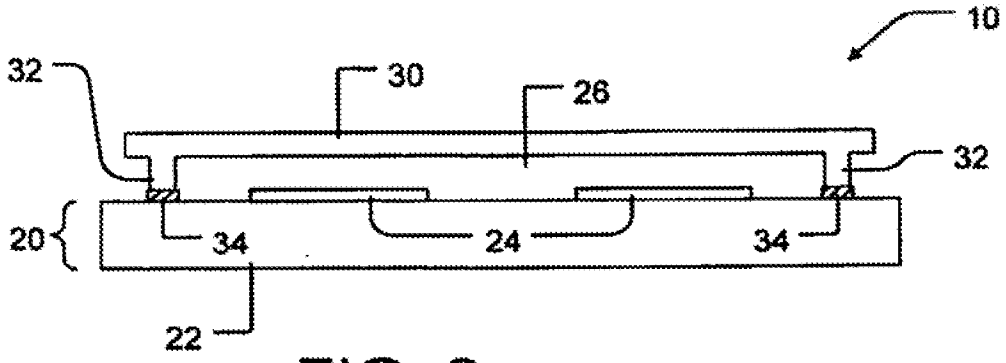


FIG. 2 (Prior art)

Fig. 2 of the Present Patent Application

Sides of the hermetically sealed cavity 26 are defined by gasket 32 which can be a part of the cap 30. The gasket 32 is attached to the substrate 22 using bonding agent 34 such as gold. To achieve the hermetically sealed cavity 26, the bonding agent 34 is applied to the substrate 22, the gasket 32, or both before they are brought together. As for the bonding metal 34, gold (chemical symbol Au) is often used but other materials can be used as the bonding agent. Then, the device chip 20 and the cap 30 are pressed together and heated to effectuate diffusion bonding. The gasket 32 can be about 1 to 10 microns thick depending on implementation. This process results in a hermetic sealing of the cavity 26; however, long-term exposure to harsh environmental conditions such as high temperature, high humidity, or both can lead to corrosion and leaking of the bond agent thus losing the hermeticity of the cavity.

Accordingly, there remains a need for a method of manufacturing an apparatus with sealed cavity that provides even higher level of protection against adverse environmental conditions.

Figure 3A is a cut-away side view of an apparatus 40 according to one embodiment of the invention. A portion 42 of Figure 3A is illustrated in more detail in Figures 3B and 3C. The apparatus 40 of Figures 3A through 3C includes portions similar to corresponding portions of the apparatus 10 of Figures 1 and 2. For convenience, portions of the apparatus 40 of Figures 3A through 3C that are similar to corresponding portions of the apparatus 10 of Figures 1 and 2 are assigned the same reference numerals; different portions are assigned different reference numerals.

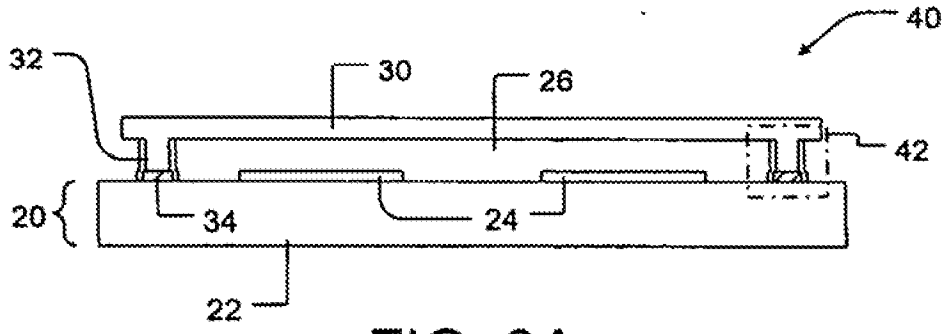


FIG. 3A

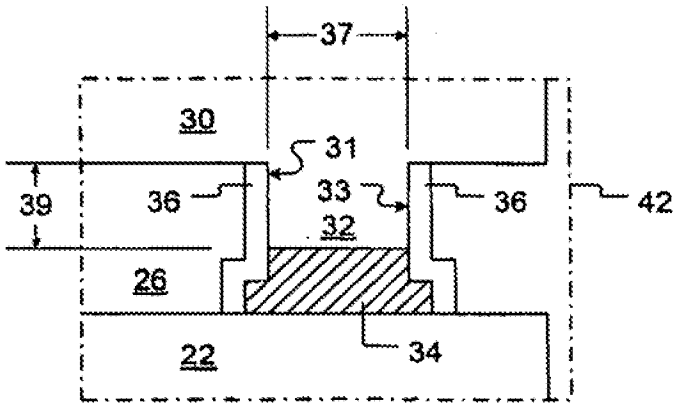


FIG. 3B

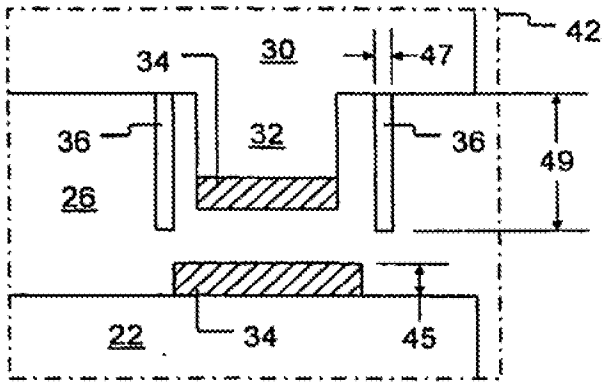


FIG. 3C

Figs. 3A, 3B and 3C of the Present Patent Application

Referring to Figures 3A and 3B, the apparatus 40 includes a device chip 20 including substrate 22 and at least one circuit element 24 fabricated on the substrate 22. The substrate 22 can be, for example, a silicon substrate 22. The circuit element 24 can be, for example, resonators, transistors, or connectors.

A cap 30, including gasket 32, is bonded to the device chip 20 such that the device chip 20 and the cap 30 define a hermetically sealed cavity 26. As illustrated, bottom of the hermetically sealed cavity 26 is defined by the device chip 20 including the substrate 22 and the circuit elements 24. Top of the hermetically sealed cavity 26 is defined by the cap 30. The sizes of the device chip 20 and the cap 30 are on the order of millimeters or fraction of millimeters. Sides of the hermetically sealed cavity 26 are defined by the gasket 32 which can be a part of the cap 30. Depending on the desired application, the gasket 32 can have thickness 37 in the order of microns or tens of microns and have a length 39 in the order of microns or tens of microns. Again, these ranges are examples only. The sizes of these portions can vary widely outside the stated ranges depending on the desired implementation.

The gasket 32 is attached to the substrate 22 using bonding agent 34 such as gold. To achieve the hermetically sealed cavity 26, the bonding agent 34 is applied to the substrate 22, the gasket 32, or both before they are brought together. As for the bonding metal 34, gold (chemical symbol Au) is often used. Then, the device chip 20 and the cap 30 are pressed together and heated to effectuate diffusion bonding. This technique is also known as thermo compression bonding. This process results in a hermetic sealing of the cavity 26.

Here, in addition to the bonding agent 34, caulking agent 36 is used to seal the cavity 26. The bonding agent 34 is thermo compressed at a temperature, "bonding temperature" that depends on the bonding agent material. For gold, a bonding temperature of ranging between, for example, approximately 600 to 670 degrees Kevin but this range can vary greatly depending on material, pressure, and time. Various materials can be used as the caulking agent 36, for example, amorphous fluorocarbon polymer such as CytopR, polyimide materials, and benzocyclobutene (BCB) based materials. It is desirable that the caulking agent 36 has dispensing and patterning properties that are compatible with the rest of the wafer manufacturing process. For example, the caulking agent and the process for depositing caulking agents should not have adverse reactions or impact against other parts of the circuit.

For example, it is desirable that the caulking agent 36 has a reflow temperature that is compatible with the rest of the bonding process. If the reflow temperature is too low, then the caulking agent 36 may not caulk the gasket 32, but rather flow throughout the die or adversely penetrate the bonding agent. If the reflow temperature is too high, then the caulking agent 36 will not flow and caulking will not occur. Additionally, the caulking agent 36 should not include material that adversely affects the device chip 20, its circuits 24, or the cap 30.

As illustrated in Figures 3A and 3B, the caulking agent 36 caulks and envelopes portions of or all of the bonding agent 34 and the gasket 32 which is a part of the cap 30. The gasket 32 has an inner surface 31 and an outer surface 33 where the inner surface 31 is exposed to the cavity 26. The caulking agent 36 can be used to caulk the inner surface 31, the outer surface 33, or both. Only one layer of the caulking agent 36 is illustrated for simplicity. However, depending on the application, two or more layers of the caulking agent 36 can be used where the

layers can be different caulking material relative to the other layers or multiple layers of the same caulking material.

The independent claim of the present application is claim 24, which is reproduced hereinbelow in its current form showing where specific support for each element recited therein may be found in the specification and drawings as originally filed (see paragraph, page and line numbers shown in italicized square brackets set forth after each element). It should be noted that support for elements and limitations recited in claim 24, in addition to that shown below, may be found in other portions of the specification, drawings and abstract of the application.

24. A hermetically sealed integrated circuit package *[paragraphs [0001], [0002] and [0003], page 1]*, comprising:

an integrated circuit comprising a substrate having an upper surface*[Fig. 3A, element 22]*, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin *[Fig. 3A, elements 22, 26 and 34]*, at least one circuit element being disposed within the hermetically sealed portion *[Fig. 3A, elements 24]*;

a hermetic cap comprising a top member and a gasket *[paragraph [0018], page 4]*, the cap being configured to cover the hermetically sealed portion and form a hermetically sealed cavity thereover *[paragraph [0018], page 4]*, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap *[paragraph [0018], pages 4 and 5; Fig. 3B, element 32]*, the sidewalls terminating in and being separated by a bottom edge *[Fig. 3B, element 32]*;

a bonding agent disposed between and engaging the substrate and the bottom edge to form a hermetic seal between the cap and the substrate and thereby hermetically seal the cavity *[paragraph [0019] and Figs. 3B and 3C, element 34]*, the bonding agent further comprising opposing second inner and second outer sidewalls disposed between

the substrate and the gasket *[paragraph [0019] and Figs. 3B and 3C, element 34]*, the second inner sidewall being located within the hermetically sealed portion *[Figs. 3B and 3C, element 34]*, the second outer sidewall being located outside the hermetically sealed portion *[Figs. 3B and 3C, element 34]*, and

a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[Figs. 3B and 3C, element 36; paragraphs [0020], [0021] and [0022], pages 5 and 6]* such that the caulking agent extends between and covers substantially all of and is in direct contact with at least one of the second inner sidewall and the second outer sidewall *[Figs. 3B and 3C, element 36; paragraphs [0020], [0021] and [0022], pages 5 and 6]*, the caulking agent extending between the substrate and the gasket *[Figs. 3B and 3C, element 36; paragraphs [0020], [0021] and [0022], pages 5 and 6]* and being configured to seal the cavity and improve the hermeticity of the hermetic seal formed by the bonding agent *[Figs. 3B and 3C, element 36; paragraphs [0020], [0021] and [0022], pages 5 and 6]*.

VI. Grounds of Rejection to Be Reviewed on Appeal

In the Final Office Action mailed July 18, 2008 the Examiner rejected claims 24-27 and 31-36 on the basis of U.S. Patent Publication No. 2004/0211966 to Guenther et al. (hereafter "the Guenther reference"), U.S. Patent Publication No. 2003/0143423 to McCormick et al. (hereafter "the McCormick reference"), U.S. Patent No. 6,717,052 to Wang et al. (hereafter "the Wang reference"), U.S. Patent No. 6,549,160 to Goldman et al. (hereafter "the Goldman reference"), and the Applicant's Prior Art, namely paragraph 3 of the present patent application (hereafter "the APA"). In support of the foregoing rejections the Examiner cited 35 U.S.C. § 103(a). Accordingly, claims 24-27 and 31-36 are the subject of this appeal, while claims 1-23 are *not* the subject of this appeal.

The particular grounds of rejection to be reviewed on appeal are therefore summarized as follows:

(1) Whether claims 24, 26, 32, 33 and 36 are unpatentable under 35 U.S.C. § 103(a) as being obvious over the Guenther reference in view of the McCormick reference;

(2) Whether claims 25 and 27 are unpatentable under 35 U.S.C. § 103(a) as being obvious over the Guenther reference in view of the McCormick and Wang references;

(3) Whether claim 31 is unpatentable under 35 U.S.C. § 103(a) as being obvious over the Guenther reference in view of the McCormick and Goldman references, and

(4) Whether claim 34 is unpatentable under 35 U.S.C. § 103(a) as being obvious over the Guenther reference in view of the McCormick reference and the APA.

VII. Arguments

A. The Examiner's Arguments

In regards to claims 24, 26, 32, 33 and 36, the Examiner stated:

In regards to claim 24, Guenther et al. ("Guenther") discloses the following:

a) an integrated circuit comprising a substrate (301) having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion (For Example: See Figure 3);

b) a hermetic cap (360) comprising a top member and a gasket (364), the cap being configured to cover the hermetically sealed portion and form a hermetically sealed cavity thereover, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap, the sidewalls terminating in and being separated by a bottom edge (For Example: See Figure 3);

c) a bonding agent (375) disposed between and engaging the substrate and the bottom edge to forma hermetic seal between the cap and the substrate and thereby hermetically seal the cavity, the bonding agent further comprising opposing second inner and second outer sidewalls disposed between the substrate and the gasket, the second inner sidewall being located within the hermetically sealed portion, the second outer sidewall being located outside the hermetically sealed portion (For Example: See Figure 3); and

d) a caulking agent (380) disposed along and engaging at least one of the second inner sidewall and the second outer sidewall (For Example: See Figure 3).

In regards to claims 24 and 26, Guenther fails to disclose the following:

a) the caulking agent extends between the covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall, the caulking agent extending between the substrate and gasket and being configured to seal the

cavity and improve the hermeticity of the hermetic seal formed by the bonding agent.

However, McCormick et al. ("McCormick) discloses a caulking agent that extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall, the caulking agent extending between the substrate and gasket and being configured to seal the cavity and improve the hermeticity of the hermetic seal formed by the bonding agent (For Example: See Figure 1A). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Guenther to include a caulking agent that extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall, the caulking agent extending between the substrate and gasket and being configured to seal the cavity and improve the hermeticity of the hermetic seal formed by the bonding agent as disclosed in McCormick because it aids in providing further protection from the atmosphere (For Example: See Paragraph 32).

Additionally, since Guenther and McCormick are both from the same field of endeavor, the purpose disclosed by McCormick would have been recognized in the pertinent art of Guenther.

In regards to claim 32, Guenther discloses the following:

a) the bonding agent comprises gold (For Example: See Paragraph 22).

In regards to claim 33, Guenther discloses the following:

a) the caulking agent comprises at least one of an amorphous fluorocarbon polymer, a polyimide material, and a benzocyclobutene based material (For Example: See Paragraph 23).

In regards to claim 36, Guenther discloses the following:

a) the substrate comprises silicon (For Example: See Figure 11).

In regards to claims 25 and 27, the Examiner stated:

In regards to claim 25, Guenther discloses the following:

a) a second inner sidewall (For Example: See Figure 3).

In regards to claim 25, Guenther fails to disclose the following:

a) the caulking agent is disposed along substantially all of the inner sidewall.

However, Wang et al. ("Wang") discloses a semiconductor device that comprises the caulking agent is disposed along substantially all of the inner sidewall (For Example: See Figure 5C). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Guenther to include a caulking agent that is disposed along substantially all of the inner sidewall as disclosed in Wang because it aids in providing protection for the device (For Example: See Abstract and Column 2 Lines 27-50).

Additionally, since Guenther and Wang are both from the same field of endeavor, the purpose disclosed by Wang would have been recognized in the pertinent art of Guenther.

In regards to claim 27, Guenther discloses the following:

a) second inner sidewall and second outer sidewall (For Example: See Figure 3).

In regards to claim 27, Guenther fails to disclose the following:

a) the caulking agent is disposed along substantially all of the inner sidewall and outer sidewall.

However, Wang discloses a semiconductor device that comprises the caulking agent is disposed along substantially all of the inner sidewall and outer sidewall (For Example: See Figure 5C). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Guenther to include a caulking agent that is disposed along substantially all of the inner sidewall and outer sidewall as disclosed in Wang because it aide in

providing protection for the device (For Example: See Abstract and Column 2 Lines 27-50).

Additionally, since Guenther and Wang are both from the same field of endeavor, the purpose disclosed by Wang would have been recognized in the pertinent art of Guenther.

In regards to claim 31, the Examiner stated:

In regards to claim 31, Guenther fails to disclose the following:

a) comprises multiple layers of the caulking agent.

However, Goldmann et al. ("Goldmann") discloses a semiconductor device that comprises multiple layers of the caulking agent (142, 152 and 54)(For Example: See Figure 1b). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Guenther to include multiple layers of the caulking agent as disclosed in Goldmann because it aids in providing protection for the device (For Example: See Column 7 Lines 30-34).

Additionally, since Guenther and Goldmann are both from the same field of endeavor, the purpose disclosed by Goldmann would have been recognized in the pertinent art of Guenther.

In regards to claim 34, the Examiner stated:

In regards to claim 34, Guenther fails to disclose the following:

a) a thickness of the gasket between the first inner sidewall and the first outer sidewall ranges between about 1 micron and about 10 microns.

However, Applicant's Prior Art ("APA") discloses a semiconductor device that a thickness of the gasket between the first inner sidewall and the first outer sidewall ranges between about 1 micron and about 10 microns (For Example: See Paragraph 3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Guenther to include a thickness of the gasket between the first inner sidewall and the first outer sidewall ranges

between about 1 micron and about 10 microns as disclosed in APA because it aids in sealing the device (For Example: See Paragraph 3).

Additionally, since Guenther and APA are both from the same field of endeavor, the purpose disclosed by APA would have been recognized in the pertinent art of Guenther.

Each of the foregoing rejections made by the Examiner is responded to in detail below.

B. Subject Matter Recited in the Independent Claims

Claim 24 of the present application recites the following:

(a) A hermetically sealed integrated circuit package, comprising:

(b) an integrated circuit comprising a substrate having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion;

(c) a hermetic cap comprising a top member and a gasket, the cap being configured to cover the hermetically sealed portion and form a hermetically sealed cavity thereover, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap, the sidewalls terminating in and being separated by a bottom edge;

(d) a bonding agent disposed between and engaging the substrate and the bottom edge to form a hermetic seal between the cap and the substrate and thereby hermetically seal the cavity;

(e) the bonding agent further comprising opposing second inner and second outer sidewalls disposed between the substrate and the gasket, the second inner sidewall being located within the hermetically sealed portion, the second outer sidewall being located outside the hermetically sealed portion, and

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall;

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall;

(h) the caulking agent extending between the substrate and the gasket;

(i) and being configured to seal the cavity;

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent.

C. The Cited References

1. The Guenther Reference

The first reference relied upon is U.S. Patent Publication No. 2004/0211966 to Guenther et al. ("the Guenther reference"), which discloses "[a] device having bond pads within a bond pad region, the bond pads comprising a conductive material that is stable when exposed to atmospheric constituents. The bond pads can be formed from conductive oxide materials such as indium tin oxide. A contact layer is provided to enhance the conductivity between the bond pads and the active component of the device." See the Abstract of the Guenther reference.

Pertinent excerpts from the Guenther reference include the following portions describing Fig. 3 thereof:

> [0011] The invention relates to improved interconnection of devices. The interconnection results in devices which are more reliable and relatively inexpensive to produce. FIG. 3 shows a device 300 in accordance with one embodiment of the invention. In one embodiment, the device comprises a substrate 301 having an active region defined thereon. The substrate comprises, for example, glass. Materials, such as silicon or other semiconductor materials, are also useful. To form flexible devices, materials such as plastics, can be used. Various other materials, which can provide sufficient mechanical stability for forming the device, are also useful.
>
> [0012] The active region comprises one or more active components of the device. In one embodiment, the active region comprises one or more OLED cells. The active region may also comprise other types of electronic components. An OLED cell comprises one or more organic layers (polymer stack) 310 sandwiched between first and

second electrodes (305 and 315). The electrodes are formed of conductive layers. The organic layers are fabricated from organic compounds that include, for example, conjugated polymers, low molecular materials, oligomers, starburst compounds or dendrimer materials. Such materials include tris-(8-hydroxyquinolate)-alu- minum (Alq), poly(p-phenylene vinylene) (PPV) or polyfluorene (PF). Other types of functional organic layers, including fluorescence or phosphorescence-based layers, are also useful.

[0013] In one embodiment, ***at least one of the electrodes comprises a conductive material which is stable when exposed to atmospheric constituents, such as water and oxygen.*** In one embodiment, the first electrode comprises a conductive material that is stable when exposed to atmospheric constituents. In one embodiment, the stable conductive material comprises a conductive oxide such as indium tin oxide (ITO). Other conductive oxides such as indium zinc oxide, zinc oxide or tin oxide, or other conductive materials which are stable when exposed to atmospheric constituents are also useful. In one embodiment, the first electrode comprises a transparent conductive material. For applications which view through the substrate, the first transparent electrode is located on the substrate, as shown in FIG. 3. For applications which view through the cap, the transparent electrode is positioned on top of the organic layer 310. The first electrode serves as, for example, the anode while the second electrode serves as, for example, the cathode.

[0014] The cathodes and anodes can be patterned as desired to form one or more OLED cells in passive display applications. For example, the cathodes and anodes are formed as strips in respective first and second directions, creating a pixelated device. Other patterns are also useful. Typically, the first and second directions are orthogonal to each other. Alternatively, the OLED display comprises an active-matrix display. The active-matrix display comprises pixels that are independently addressed by thin-film-transistors

(TFTs) and capacitors formed in an electronic backplane.

[0015] In one embodiment, a cap 360 is bonded to the substrate in the cap bonding region surrounding the active region, encapsulating the OLED cells. ***The cap creates a cavity 345 to protect the cells from being damaged by physical contact with the cap***. In one embodiment, the cap comprises a cap substrate with a sealing rim or gasket 364 formed thereon. The cap substrate can be formed from, for example, glass. Other materials which can serve as a cap substrate, such as metal or ceramic, can also be used. The sealing rim, for example, can be formed from photoresist. Other types of materials, such as silicate glass, silicon-dioxide, or ceramic can also be used. An adhesive may be used to bond the cap to the substrate. The adhesive, for example, comprises resins based on epoxy, silicone, urethane, acrylate or olefinic chemistries. The resin can be a UV or thermally curable resin. Providing a sealing rim formed from an epoxy adhesive is also useful. Alternatively, the cap is a pre-formed cap comprising, for example, pressed metal or etched glass.

[0016] The active region of the device can, for example, include shaped pillars. The shaped pillars, which comprise an undercut, are used to pattern the top electrodes. The use of shaped pillars is described in, for example, "Production of Structured Electrodes" (US 2001/0017516A1) and "Patterning of Electrodes in OLED Devices" (PCT/SG00/00134), which are herein incorporated by reference for all purposes. Alternatively or in addition to shaped pillars, spacer particles can be provided on the substrate. The spacer particles serve to support the cap, preventing it from contacting the OLED cells. The use of spacer particles is described in, for example, "Encapsulation of Electronic Devices"(U.S. Ser. No. 09/989,362); "Improved Encapsulation of Organic LED devices" (PCT/SG99/00145); "Organic LED Device with Improved Encapsulation" (PCT/SG99/00143); and "Improved Encapsulation for Organic LED Device" (PCT/SG99/00145), which are herein incorporated by reference for all

purposes.

[0017] A surface protection layer (not shown) may be provided on the substrate in the cap bonding area. The cap contacts the surface protection layer. Various layers beneath the surface protection layer, for example, metal interconnects for the electrodes and/or electrodes (e.g., ITO), are protected from damage during removal of the polymer material. The use of a surface protection layer is described in, for example, patent application titled "Encapsulation for Electroluminescent Devices" U.S. Ser. No. 10/142,208 (attorney docket no. 12205/16), which is herein incorporated by reference for all purposes.

[0018] A bond pad region is provided in which bond pads are located. In one embodiment, the bond pad region surrounds the active area and extends beyond the cap bonding region. Providing a bond pad region which surrounds the cap bonding region is also useful. A bond pad includes first (lead) and second (pad) regions. The pad region is where contact is made to, for example, driving circuitry. Typically, the lead portion extends from the pad portion toward the active region.

[0019] In accordance with the invention, the bond pads comprise a conductive material that is stable when exposed to atmospheric constituents, such as water and air. In one embodiment, the conductive material comprises a conductive oxide. For example, the conductive oxide comprises indium tin oxide, indium zinc oxide, zinc oxide or tin oxide. Other types of conductive oxides or conductive materials which are stable when exposed to atmospheric constituents are also useful.

[0020] In a preferred embodiment, the bond pads and first electrodes are formed from the same conductive layer. Forming bond pads and first electrodes from different layers and/or materials are also useful. The conductive layer that forms the bond pads and first electrodes, in one embodiment, comprises a conductive oxide which is stable conductive material. Preferably, the conductive

material of the bond pads and first electrodes exhibits good adhesion to the substrate as well as to the connector coupled to the driving circuitry. This improves the reliability of the interconnection.

[0021] The lead portion of the bond pads can be directly (e.g., part of) or indirectly (e.g., separated from) the active components (e.g., electrodes). As an example, the lead portion of the bond pads which are to be coupled to the first electrode can be integrated as part of the first electrode (e.g., formed from the same layer) while the bond pads which are to be coupled to the second electrodes are indirectly coupled to the second electrodes.

[0022] In one embodiment of the invention, contact conductors 375 are provided. The contact conductors serve to electrically couple the bond pads 377 to the active components and/or enhances the connectivity therebetween. The conductor preferably comprises a conductive metal (e.g. Al, Au, Ag, Cu, Cr or Ni). Other conductive materials are also useful. The conductors comprise a dimension which is sufficient to produce the desired electrical characteristics. Typically, the thickness of the conductors is about 100-1000 nm. Other thicknesses are also useful.

[0023] In one embodiment, ***a protection layer 380 is provided to encapsulate the conductors, protecting them from exposure to atmospheric constituents that may cause damage or corrosion. The protection layer preferably comprises an insulating material, such as photoresist, novolak resin, polyimide or polybenzoxazole may be used. Other types of materials which protect the contact layer from the atmospheric constituents are also useful.***

[0024] The contact conductors, in one embodiment, do not extend into pad portion of the bond pads. For example, the conductors contact the lead portions of the bond pads and the active components. Preferably, the contact conductors terminate sufficiently before the pad portion to enable the conductors to be completely encapsulated without

covering the pad portions, allowing interconnections between the pad portions and connectors. Hence, the conductors are not exposed to detrimental reaction with atmospheric constituents such as water or oxygen.

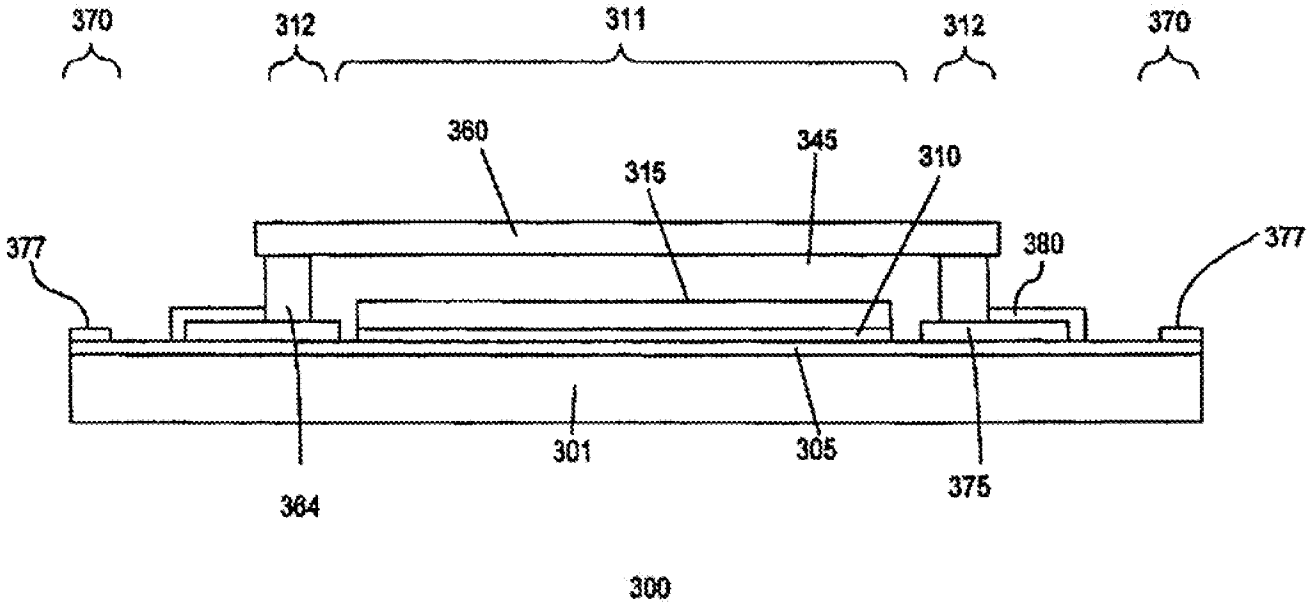


Fig. 3 of the Guenther Reference

As shown in the above excerpts from the Guenther reference and Fig. 3 thereof reproduced hereinabove, the Guenther reference discloses an adhesive 364 and a protection layer 380 provided to encapsulate conductors 375 to protect conductor 375 from exposure to atmospheric constituents that may cause damage or corrosion. Indeed, reference to Fig. 3 and the above excerpts from the Guenther reference shows that protection layer 380 is disposed over portions of conductors 375 ***that would otherwise be exposed to the atmosphere.*** Protection layer 380 incidentally engages only a very small portion of adhesive 364 (see Fig. 3 below), and has the express stated purpose of "***protecting [the conductors] from exposure to atmospheric constituents that may cause damage or corrosion.***" As disclosed and illustrated in the Guenther reference, protection layer 380 provides no hermetic sealing function or purpose. Consequently, the structural relationship between protection layer 380 and adhesive 364 illustrated in the Guenther reference shows that layer 380 is incapable of increasing the hermeticity of adhesive 364, even if protection layer 380 and adhesive layer 364 were somehow capable of providing a hermetic seal (which in any event they are not).

2. The McCormick Reference

The second reference relied upon is U.S. Patent Publication No. 2003/0143423 to McCormick et al. ("the McCormick reference"), which discloses " . . . organic electronic devices that are encapsulated at least in part by adsorbent-loaded transfer adhesives. The adsorbent material may be a dessicant and/or a getterer. The adsorbent-loaded transfer adhesive may form a gasket around the periphery of the device, or may cover the entire device and its periphery. An encapsulating lid covers the device." See the Abstract of the McCormick reference.

Pertinent excerpts from the McCormick reference include the following portions describing Figs. 1A through 2B and other portions thereof:

> [0002] Organic electronic devices (OEDs) are articles that include layers of organic materials, at least one of which can conduct an electric current. Illustrative examples of known OED constructions include organic transistors, photovoltaic devices, rectifiers, and organic light emitting diodes (OLEDs). Heat, light, oxygen, and moisture adversely affect many of the inorganic materials, such as low work function electrodes, and the organic materials that are used in OEDs. ***It is important, therefore, to protect these materials from exposure to the open air. OED devices thus require hermetic packaging in order to achieve the long lifetimes required for many applications.*** For an OLED, this typically consists of attaching a glass or metal cap onto the cathode side of the device, as described in, e.g., U.S. Pat. Nos. 5,874,804 and 5,686,360, respectively. As described in, e.g., JP 00123968, ***desiccants are often placed inside the hermetically sealed device to absorb moisture that may be generated by the cure of the adhesive or that may enter the device through***

adhesive bond line. Oxygen getterers may also be placed inside the sealed device to absorb any oxygen that may enter the device through the sealing adhesive, as described in, e.g., U.S. Pat. Nos. 5,304,419 and 5,591,379; and JP 07-169567. Typical desiccants include fine powders of BaO or CaO. Typical oxygen getterers include finely divided metals such as magnesium and iron. Care must be taken to prevent these fine powders from contacting the OLED to avoid abrasion damage, electrical shorting, and the like. The desiccant and/or getterer is thus often placed in a dimple in the metal or glass sealing cap and held in place by a permeable membrane.

[0004] ***The present invention recognizes the need for effective, easy-to-apply adhesive sealants containing adsorbent materials. The present invention features the use of adsorbent (desiccant and/or getterer) loaded transfer adhesives to adhere an encapsulation lid to an organic electronic device (OED) as part of an encapsulation method. The adsorbent loaded transfer adhesives function as a structural adhesive to hold the encapsulating lid in place as well as providing a means to absorb oxygen and/or moisture.***

[0021] The present invention can provide a robust OED device by providing ***a sealing and adsorbing medium around an OED, which protects the OED device from water vapor and other gases***. Using an adsorbent and/or getterer loaded transfer adhesive for encapsulation can improve the performance of such OEDs as organic transistors, photovoltaic devices, rectifiers, and organic light emitting diodes (OLEDs).

[0026] Articles of the present invention include various encapsulation constructions. For example, the adsorbent loaded transfer adhesive may form a gasket that surrounds the periphery of an OED ["Organic Electronic Devices"] and adheres the encapsulation lid to the substrate, as illustrated in FIG. 1. Alternatively, the adsorbent loaded transfer adhesive may form a continuous layer between the

OED and an encapsulation lid that also adheres the encapsulation lid to the substrate, as illustrated in FIG. 2. In making an encapsulated structure, the transfer adhesive may be applied to the substrate/device structure or may be applied to the encapsulating lid before these two components are joined together. Suitable encapsulation lids may be made of metals, glass, ceramics, or plastics, for example, stamped metal foils, plastic circuit boards, ceramic cans, glass plates, machined metal cans, and semiconductor substrates. The lid may be transparent or opaque, depending on the desired construction of the OED.

[0027] Device 10 of FIG. 1 is comprised of substrate 12 on which are located cathode pad 14 and anode pad 16. Organic emissive element 18 contacts both cathode pad 14 and anode pad 16. Cathode 20 contacts emissive element 18 and cathode pad 14. ***Desiccant-loaded transfer adhesive 22 forms a gasket around the OED structure covering its periphery, and is topped with encapsulation lid 24. Optional high barrier adhesive 26 encompasses transfer adhesive 22 and extends from substrate 12 to encapsulation lid 24.***

[0028] Device 30 of FIG. 2 is comprised of substrate 12 on which are located cathode pad 14 and anode pad 16. Organic emissive element 18 contacts both cathode pad 14 and anode pad 16. Cathode 20 contacts emissive element 18 and cathode pad 14. ***Desiccant-loaded transfer adhesive 32 covers the entire OED structure and its periphery, and is topped with encapsulation lid 24. An optional high barrier adhesive (not shown) can encompass transfer adhesive 32 and extend from substrate 12 to encapsulation lid 24.***

[0029] The adsorbent loaded transfer adhesives suitable for the present invention may be made of pressure sensitive adhesives, hot melt adhesives, thermoset adhesives, actinic radiation curable adhesives (such as UV and visible light curable), electron beam curable adhesives, curable pressure sensitive adhesives, or various combinations thereof. The transfer adhesives are already in film

form prior to being applied to the OED structure. The transfer adhesive may comprise a carrier film having adhesive coated on both sides, as in a double-sided adhesive tape; a free-standing film; or an adhesive layer on a removable liner.

[0030] The transfer adhesives may be made by any suitable method known in the art to create an adhesive film layer such as extrusion, hot pressing, solvent coating, and 100% solids radiation cured coating.

[0031] Examples of materials suitable for making the transfer adhesive include pressure sensitive adhesives (PSA) made from acrylates such as Ultra-Clean Laminating Adhesive 501FL and Optically Clear Laminating Adhesive 8141 both available from 3M Bonding Systems Division, St. Paul, Minn., rubbers such as KRATON styrenic block copolymers from Shell Chemicals, Houston, Tex., silicones such as RHODOTAK 343 from Rhodia Silicones, Lyon, France, and polyolefins such as poly(1-hexene), poly(1-octene), and poly(4-ethyl-1-octene) described in U.S. Pat. No. 5,112,882; hot melt adhesives such as unloaded versions of the tackified polyamide-polyether copolymers described in U.S. Pat. No. 5,672,400 and the thermoplastic polymer adhesive films described in U.S. Pat. No. 5,061,549; curable adhesives, thermosets, and crosslinking systems such as the unloaded versions of the epoxy/thermoplastic blends described in U.S. Pat. No. 5,362,421; the cyanate ester/ethylenically unsaturated semi-IPNs described in U.S. Pat. No. 5,744,557; and the epoxy/acrylate compositions described in WO 97/43352. Various combinations of pressure sensitive adhesive, hot melt, and curable adhesives may be useful in the practice of the invention.

[0032] Once the transfer adhesive is made, it is cut into a suitable shape, e.g., by die cutting or other suitable means, and may then be applied to the OED structure. If the transfer adhesive is cut into a gasket shape it is applied around the exterior of the OED structure. If the transfer adhesive shape is a

continuous layer, it may be applied directly onto the OED structure, so that it covers the structure and its periphery. The encapsulating lid is then applied to the device and transfer adhesive thereby sealing the device. ***The lid is preferentially applied in an oxygen- and/or moisture-free environment, such as dry N.sub.2 gas, to prevent trapping undesirable atmospheric components adjacent to the OED.*** Heat, pressure, and actinic radiation may be used to provide a complete seal, and if appropriate, cure the transfer adhesive. Alternatively, the transfer adhesive may be applied to the encapsulation lid instead of the OED/substrate structure, then the lid is applied onto the OED structure (adhesive side down). ***A high barrier adhesive may then be applied around the periphery of the encapsulation lid, if desired, to provide further protection from the atmosphere and additional bonding of the lid to the substrate.***

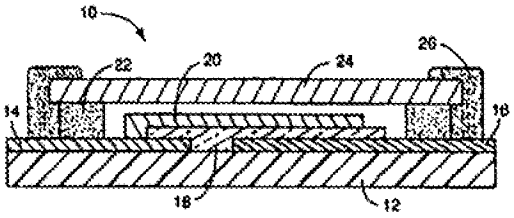


FIG. 1A

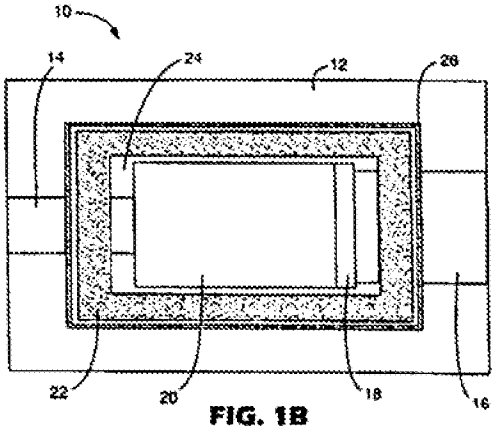


FIG. 1B

Figs. 1A and 1B of the McCormick Reference

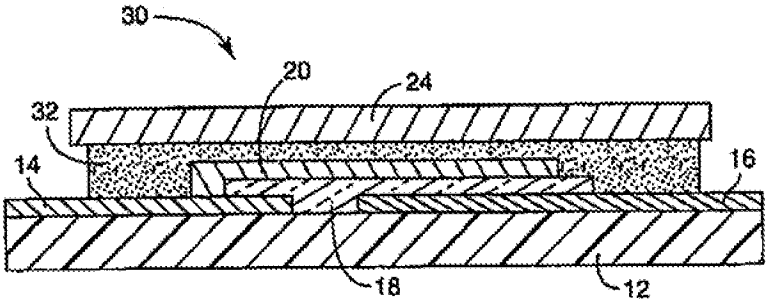


FIG. 2A

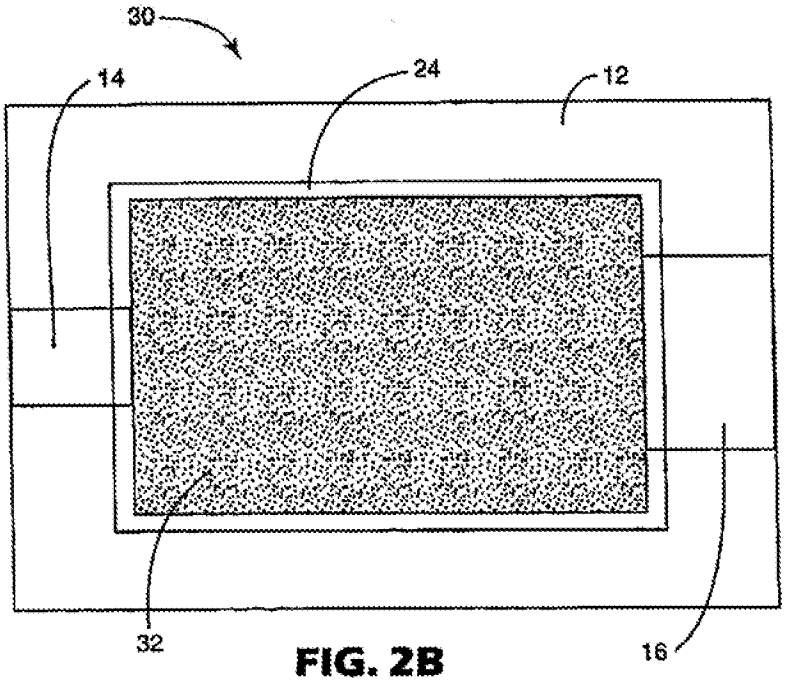


FIG. 2B

Figs. 2A and 2B of the McCormick Reference

As shown in the above excerpts from the McCormick reference and Figs. 1A through 2B thereof reproduced hereinabove, the McCormick reference discloses a lid 24 adhesively connected to substrate 12 by means of dessicant-loaded transfer adhesive 22, which forms a gasket around the periphery of the OED structure. Optional high barrier adhesive 26 encompasses dessicant transfer adhesive 26 and extends from substrate 12 to encapsulation lid 24. The stated purpose of such a structure is to provide a sealing and adsorbing medium around an OED, which protects the OED device from water vapor and other gases, and through the use of an adsorbent and/or getterer, can improve the performance of an OED.

The McCormick reference does not disclose a gasket having a bottom edge attached to a substrate disposed therebeneath by means of a bonding agent disposed therebetween (as is recited in and required by the claims), or a caulking agent disposed along at least one of the inner and outer sidewalls formed by the bonding agent (as is also recited in and required by the claims), thereby to form an hermetic seal between the exterior of device 40 and the hermetically sealed cavity 26 disposed therewithin (as is further recited in and required by the claims).

Instead, the basic concept behind devices 10 and 30 disclosed in the McCormick reference is to intercept moisture that might leak inside device 10 or 30 and adsorb or absorb such moisture using dessicant-loaded transfer adhesive 22 or 32. Thus, the seals formed by adhesives 22, 26 and 32 in devices 10 and 30 of McCormick are by their very nature NOT hermetic since the ingress of moisture therein and therethrough is anticipated by the designs thereof. Moreover, McCormick's seals operate in a

manner completely different from those of the claimed invention, where at least dual hermetic barriers and seals prevent the ingress of moisture or gases into hermetically sealed cavity 26 (as is recited in and required by the claims).

Finally, the McCormick reference teaches firmly away from the invention recited in the claims by directing the reader's attention to prior art glass or metal caps with dessicants placed inside an OED device (see, for example, paragraph [0002] of the McCormick reference) and to the invention described therein, where dessicant adhesives are used to substitute for the functionality formerly provided by dessicants placed inside a device. Nowhere does the McCormick reference disclose the use of bonding agents such as gold to form an hermetic seal between a cap and a substrate.

3. The Wang Reference

The third reference relied upon is U.S. Patent No. 6,717,052 to Wang et al. ("the Wang reference"), which discloses "[a] housing structure used for a display device. A transparent substrate is provided with a completed luminescent device. The rim of the transparent substrate is bonded to the rim of a sealing cap to form an airtight space. A sealing structure with a first sealing layer and a second sealing layer is provided on the bonding rim between the sealing cap and the transparent substrate. The materials used to form the first sealing layer and the second sealing layer are different." See the Abstract of the Wang reference.

Pertinent excerpts from the Wang reference include the following portions:

> A housing structure used for a display device. A transparent substrate is provided with a completed luminescent device. The rim of the transparent substrate is bonded to the rim of a sealing cap to form an airtight space. A sealing structure with a first sealing layer and a second sealing layer is provided on the bonding rim between the sealing cap and the transparent substrate. The materials used to form the first sealing layer and the second sealing layer are different. *Abstract of the Wang reference.*

> The present invention provides a housing structure and a housing process to solve the problems found in the prior art. A transparent substrate is provided with a completed luminescent device. The rim of the transparent substrate is bonded to the rim of a sealing cap to form an airtight space. A sealing structure with a first sealing layer and a second sealing layer is provided on the bonding rim between the sealing cap and the transparent substrate. The materials used to form the first

sealing layer and the second sealing layer are different.

Accordingly, it is a principal object of the invention to provide a housing structure to prolong active lifetime of display device.

It is another object of the invention to provide a housing structure to improve resistance to moisture and oxygen.

Yet another object of the invention is to provide a housing structure to improve adhesion.

These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings. *Col. 2, lines 27-50 of the Wang reference.*

FIG. 5C is a sectional diagram showing a third housing structure according to the second embodiment of the present invention. Unlike the first housing structure, in an organic EL element 50C, a third rib 56 is formed on the rim of the transparent substrate 42 and disposed between the first rib 52I and the second rib 52II. Therefore, the second sealing layer 46II is coated in a space between the first rib 52I and the third rib 56, and in a space between the second rib 52II and the third rib 56. Col. 5, lines 13-21 of the Wang reference.

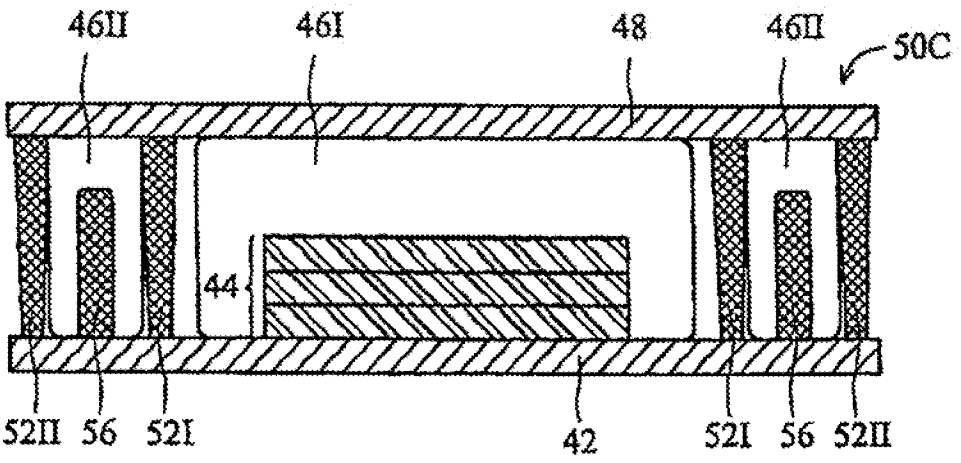


FIG. 5C

Fig. 5C of the Wang Reference

As shown in the above excerpts from the Wang reference and Fig. 5C thereof, the Wang reference discloses two different sealing layers, 46I and 46II, which are separated by ribs 52Ia and not in contact with one another. While the housing disclosed and shown in the Wang reference features first and second sealing layers 46I and 46II, the seals are not in contact with one another, are separated from one another by one or more ribs 52I, 52II and 56, and are not disclosed as forming hermetic seals. Indeed, nowhere does the Wang reference employ or disclose the terms "hermetic" or "hermetically." In addition, the Wang reference does not disclose caulk or caulking materials. Instead, the sealing materials disclosed in the Wang reference are limited to "ceramic, polymer, metal or composite" (see, for example, col. 3, lines 63-67 of the Wang reference). There is no discussion or disclosure anywhere in the Wang reference of a caulking agent improving the hermeticity of a seal provided by a bonding agent, or being disposed directly thereover. Is also noteworthy that the complicated housing sealing structure of the Wang reference consumes substantially more volume than that of the presently claimed invention, where the caulking agent is in direct contact with and overlies one or another, or both, of the sidewalls formed by the bonding agent instead of discrete and separate compartments formed by ribs having sealing layers disposed therewithin.

4. The Goldmann Reference

The fourth reference relied upon is U.S. Patent No. 6,459,160 to Goldmann et al. ("the Wang reference"), which discloses "[a] sealed electronic circuit module includes a ceramic chip carrier with a top surface, a cover having a mating surface and a seal at the periphery of the carrier between the carrier and the cover. The seal includes a non-metallic soft lower frame, preferably polyimide, atop the carrier at the periphery of the carrier. There is an upper adhesion layer shaped as a matching an upper frame facing downwardly from the cover towards the lower frame. Above the soft lower frame is a lower metal adhesion layer. Between the upper frame and the lower adhesion layer is a solder layer which has been heated to seal the cover to the chip carrier. The soft frame can include a channel through which a metal to metal via-seal is formed by the lower metal adhesion layer and the solder through the channel through the soft layer or there can be a lateral extension of the lower metal adhesion layer to a distal location beyond the periphery of the soft lower frame." See the Abstract of the Goldmann reference.

Perusal of the Goldmann reference shows that it discloses a package with a low-stress hermetic seal. We refer now to pertinent portions of the Goldmann reference, including Figs. 2 and 3E thereof, reproduced below:

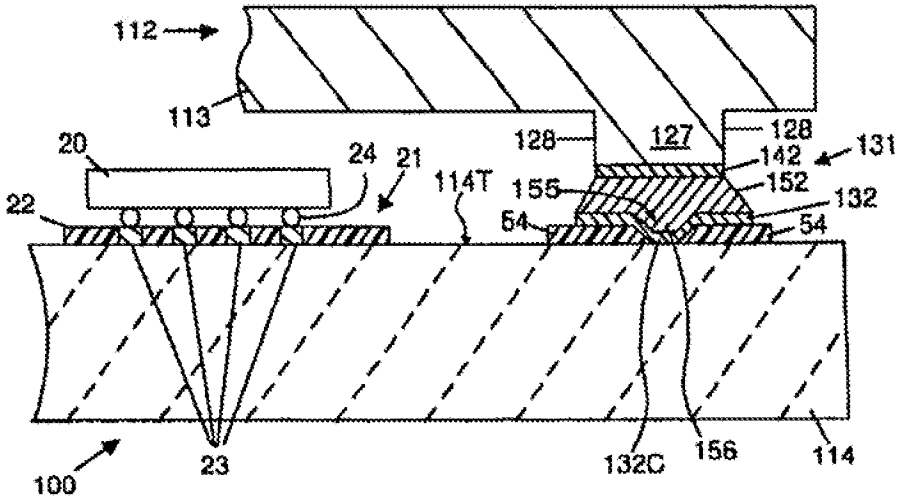


FIG. 2

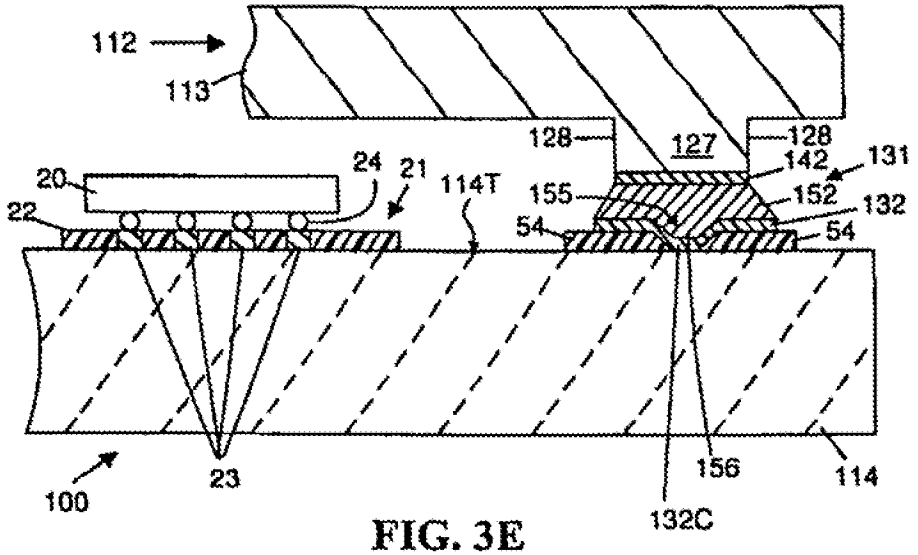


FIG. 3E

Fig. 2 and 3E of the Goldmann Reference

FIG. 2 is a schematic diagram a cross-section of a fragment of a semiconductor module 100 illustrating the structure of a preferred embodiment of this invention.

The module 100 includes a chip carrier 114 and a rectangularly shaped chip cover 112, fragments of which are shown bonded together. The chip cover 112 has a top 113 and four vertical sides 127. The sides127, which have vertical sidewalls 128, are joined at their bottoms surfaces to the periphery of the top surface of the chip carrier 114 by a hermetic sealing structure 131. That is to say that thee hermetic sealing structure 131 is formed between bottoms of the sides 127 of cover 112 and the border of the top surface of the chip carrier 114, in accordance with this invention. A via-seal 156 is formed by solder 152 which is located in a position that is remote from the high-stress edges of the lower adhesion frame 132. The solder 152 which fills a narrow via-seal channel 155 is separated from the high-stress edges of the lower adhesion frame 132 by a soft, polymeric cushion-frame 54. This separation between the solder and the high stress edges is provided to protect the chip carrier 114 from the stresses generated between the solder and the high stress edges of the lower adhesion frame 132.

Inside the cover 112, a electronic-circuit-bearing, semiconductor chip 20 is shown supported by an optional interconnect structure 21 which is formed on the surface of the chip carrier 114. In this embodiment, the interconnect structure 21 comprises an insulating layer 22 which has metal vias 23 extending from the top surface of layer 22 to contacts (not shown) in the chip carrier 114. The chip 20 (which may represent just one of a plurality of chips 20 formed in an x-y array as seen in FIG. 4E, is connected to the vias 23 in the interconnect structure 21 by connectors which are shown as C4 solder ball junctions 24 in this embodiment of the invention.

The hermetic sealing structure 131 is provided to protect the chip or a plurality of chips 20 or other elements and the circuits on the surface of the chip carrier 114 which need to be protected from the ambient atmosphere outside of the module 100. *Col. 6, line 63 through col. 7, line 35 of the Goldmann reference.*

FIG. 3E shows the device 100 of FIG. 3D after the solder frame preform 152 has been heated to its melting point so that the solder frame preform 152 melts and flows down into the upper, via-seal channel 155 (shown in FIGS. 3C and 3D) forming a solder frame 152' conforming with the surface of the metal lower adhesion frame 132. A metal cover adhesion frame 142, which is formed on the bottom of the sides 127 of the cover 112, is bonded to the solder frame 152'. The solder frame 152' , which fills the via-seal channel 155 has formed a metal via-seal 156 is formed in the channel 155 by the heating of the solder frame preform 152 until it melts thereby filling the via-seal channel 155 midway between the outer and inner edges of the soft, polymeric cushion-frame 54. The solder frame 152' forms the metal-to-metal via-seal 156 in the channel 155 above the thin metal lower adhesion frame 132. Note that the metal cover adhesion frame 142 is formed on the bottom surfaces at the bases of the four sides 127 of the cap 112 confronting the solder frame preform 152 and thus provides full hermeticity. The via-seal 156, formed by the solder frame 152' filling the via-seal channel 155, is narrow and the separation provided by the soft, polymeric cushion-frame 54 protects the chip carrier 114 which is remote from the high-stress edges of the lower adhesion frame 132 as can be seen by reference to FIGS. 3A-3C and the text relative found herein below. *Col. 8, lines 1 through 25 of the Goldmann reference.*

The above excerpts and portions from the Goldmann reference show that a hermetic seal is provided between chip cover 112 and chip carrier 114, where the seal comprises solder 152, polymeric cushion frame 54, metal cover adhesion frame 142, and lower adhesion frame 132. The vertically stacked arrangement of seal components 142, 152, 132 and 54 means that failure of the seal provided by any one of such components will result in a compromised and non-hermetic seal. That is, ***none of the seal components disclosed in the Goldmann reference improves the hermeticity of any other seal component disclosed therein.*** The Goldmann reference certainly contains no disclosure of a caulking agent that acts to improve the hermeticity of any of the seal components disclosed therein.

4. The Applicant's Prior Art

The fifth reference relied upon is the Applicant's Prior Art ("the APA").

Perusal of the APA shows that it merely discloses the state of the art regarding hermetic seal technology for integrated circuits and integrated circuit substrates. ***Nowhere does the APA disclose a caulking agent,*** let alone a caulking agent applied to a bonding agent that improves the hermeticity of the seal provided by the bonding agent. Instead, the APA discloses a conventional hermetic seal provided by a bonding agent alone. The APA consists of Fig. 2 and paragraph 3 of the present patent application, which are reproduced hereinbelow:

> Figure 2 illustrates a cut-away side view of the apparatus 10 of Fig. 1 after the bonding process. The hermetically sealed cavity is indicated with reference number 26. As illustrated, bottom of the hermetically sealed cavity 26 is defined by the device chip 20 including the substrate 22 and the circuit elements 24. Top of the hermetically sealed cavity 26 is defined by the cap 30. The size of the device chip 20 and the cap 30 can vary greatly depending on implementation but can be, for example, on the order of millimeters (mm) or fractions of millimeters, for example, about 0.5 mm to 2 mm. *Paragraph 3 of the APA.*

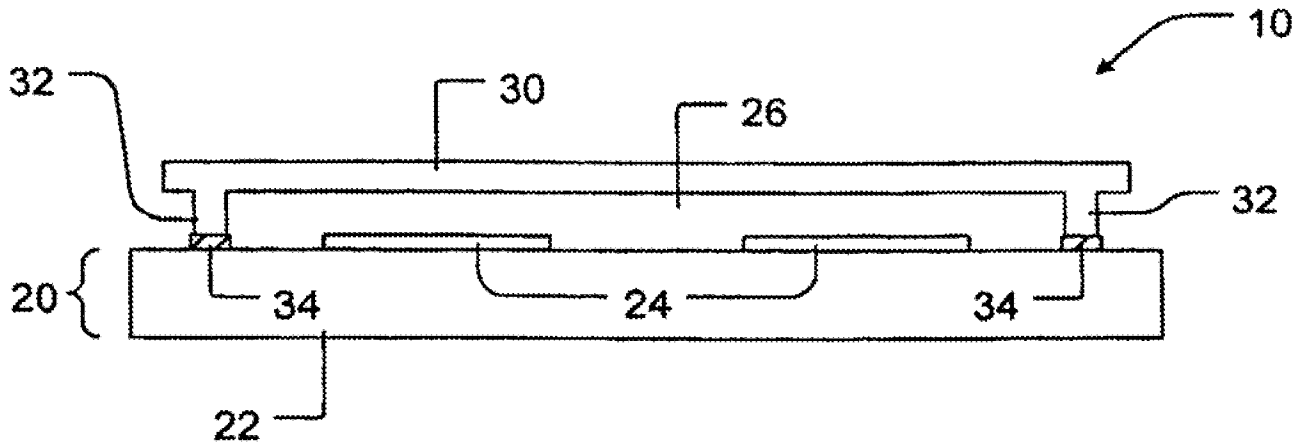


FIG. 2

Fig. 2 of the APA

D. Applicant's Arguments

(1) Claims 24, 26, 32, 33 and 36 are not obvious over the Guenther reference in view of the McCormick reference

Comparison of the elements and limitations appearing in claim 24 as amended herein (and which are also included in claims 26, 32, 33 and 36) to the Guenther reference shows that the Guenther reference does not disclose ***at least*** the following elements and limitations included in all such claims as they are enumerated in Section IV above:

(a) A hermetically sealed integrated circuit package, comprising *[the Guenther reference discloses OLED devices, not sealed integrated circuit packages];*

(b) an integrated circuit comprising a substrate having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion *[the Guenther reference discloses OLED devices, not integrated circuits];*

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[the Guenther reference discloses no caulking agents];*

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall *[the Guenther reference discloses no caulking*

agent covering substantially all an inner outer sidewall of a bonding agent and in contact therewith];;

(h) the caulking agent extending between the substrate and the gasket *the Guenther reference discloses no caulking agent extending between a substrate and a gasket];*

(i) and being configured to seal the cavity *[the Guenther reference discloses no caulking agent sealing a cavity, in addition to a bonding agent hermetically sealing the same cavity];*

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent *[the Guenther reference discloses no caulking agent improving the hermeticity of a seal formed by a bonding agent].*

In the Final Office Action, the Examiner asserted that the Guenther reference disclosed all elements recited in claim 24 as presented above in Section VII(B) except for elements (f), (g), (h) and (i). As shown above, however, at least seven elements and limitations recited in claim 24 as amended herein (and from which claims 26, 32, 33 and 36 depend) are nowhere to be found in the Guenther reference.

As discussed above, the Guenther reference discloses an adhesive 364 and a protection layer 380 provided to encapsulate conductors 375 to protect conductor 375 from exposure to atmospheric constituents that may cause damage or corrosion. Indeed, reference to Fig. 3 and the above excerpts from the Guenther reference shows that protection layer 380 is disposed over portions of conductors 375 that would otherwise be exposed to the atmosphere. Protection layer 380 incidentally engages only a very small portion of adhesive 364 (see Fig.

3 below), and has the express stated purpose of "***protecting [the conductors] from exposure to atmospheric constituents that may cause damage or corrosion.***" As disclosed and illustrated in the Guenther reference, protection layer 380 provides no hermetic sealing function or purpose. Consequently, the structural relationship between protection layer 380 and adhesive 364 illustrated in the Guenther reference shows that layer 380 is incapable of increasing the hermeticity of adhesive 364, even if protection layer 380 and adhesive layer 364 were somehow capable of providing a hermetic seal (which in any event they are not).

Comparison of the various elements and limitations recited in claims 24, 26, 32, 33 and 36 to the McCormick reference yields similar results (namely, many elements and limitations recited in those claims are missing from the McCormick reference). The McCormick reference does not disclose ***at least*** the following elements and limitations included in all such claims as they are enumerated in Section VII(B) above:

(a) A hermetically sealed integrated circuit package, comprising *[the McCormick reference does not disclose integrated circuit packages]:*

(b) an integrated circuit comprising a substrate having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion *[the McCormick reference does not disclose an integrated circuit];*

(c) a hermetic cap comprising a top member and a gasket, the cap being configured to cover the hermetically sealed

portion and form a hermetically sealed cavity thereover, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap, the sidewalls terminating in and being separated by a bottom edge *[the McCormick reference does not disclose a cap having a gasket]*;

(d) a bonding agent disposed between and engaging the substrate and the bottom edge to form a hermetic seal between the cap and the substrate and thereby hermetically seal the cavity *[the McCormick reference does not disclose a bonding agent disposed between a substrate and a gasket, and does not disclose a seal capable of forming an hermetic seal]*;

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[the McCormick reference does not disclose a caulking agent]*;

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall *[the McCormick reference does not disclose a caulking agent in contact with and covering a bonding agent]*;

(h) the caulking agent extending between the substrate and the gasket *[the McCormick reference does not disclose a caulking agent extending between a substrate and a gasket]*;

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent *[the McCormick reference does not disclose a caulking agent improving the hermeticity of a hermetic seal formed by a bonding agent]*.

As discussed above, the McCormick reference discloses a lid 24 adhesively connected to substrate 12 by means of dessicant-loaded transfer adhesive 22, which forms a gasket around the periphery of the OED structure. Optional high barrier adhesive 26 encompasses dessicant transfer adhesive 26 and extends from substrate 12 to encapsulation lid 24. The stated purpose of such a structure is to provide a sealing and adsorbing medium around an OED (which protects the OED device from water vapor and other gases) through the use of an adsorbent and/or getterer.

The McCormick reference does not disclose a gasket having a bottom edge attached to a substrate disposed therebeneath by means of a bonding agent disposed therebetween (as is recited in and required by the claims), or a caulking agent disposed along at least one of the inner and outer sidewalls formed by the bonding agent (as is also recited in and required by the claims), thereby to form an hermetic seal between the exterior of device 40 and the hermetically sealed cavity 26 disposed therewithin (as is further recited in and required by the claims).

Instead, the basic concept behind devices 10 and 30 disclosed in the McCormick reference is to intercept moisture that might leak inside device 10 or 30 and adsorb or absorb such moisture using dessicant-loaded transfer adhesive 22 or 32. Thus, the seals formed by adhesives 22, 26 and 32 in devices 10 and 30 of McCormick are by their very nature NOT hermetic since the ingress of moisture therein and therethrough is anticipated by the designs thereof. Moreover, McCormick's seals operate in a manner completely different from those

of the claimed inventions where at least dual hermetic barriers and seals prevent the ingress of moisture or gases into hermetically sealed cavity 26 (as is recited in and required by the claims).

Finally, the McCormick reference teaches firmly away from the invention recited in the claims by, for example, directing the reader's attention to prior art glass or metal caps with dessicants placed inside an OED device (see, for example, paragraph [0002] of the McCormick reference) and to the dessicant-loaded adhesives described therein, where dessicant adhesives are used to substitute for the functionality formerly provided by dessicants placed inside a device. Nowhere does the McCormick reference disclose the use of bonding agents such as gold to form an hermetic seal between a cap and a substrate.

In addition, and in view of the above discussion regarding the respective contents of the Guenther and McCormick references, it will now become clear that there is no combination of the disparate elements disclosed in the two references that can produce elements that are missing from both such references, namely elements (a), (b), (f), (g), (h) and (j). In other words, no combination of the various elements disclosed in the Guenther reference and the McCormick reference can produce ***the at least six elements missing therefrom*** with respect to the elements and limitations recited in claims 24, 26, 32, 33 and 36.

The Applicants have discovered that a certain novel combination of packaging, bonding, integrated circuit, sealing and semiconductor elements combined and configured in a certain order are required to produce the beneficial effects of the invention. As demonstrated above, ***many interconnected elements and limitations recited in claims 24, 26, 32, 33 and 36 are neither disclosed nor suggested anywhere in the Guenther or McCormick references***, and accordingly cannot be *prima facie* obvious.

Merely asserting that "would be obvious to try" the invention by making reference to the adhesive and protection layer of the Guenther

reference, and the dessicant-loaded adhesive and high barrier layers of the McCormick reference, while essentially creating other claimed elements out of whole cloth without referring to any specific portions of the cited references to establish a motivation for combining elements or functionality disclosed therein, does not establish a *prima facie* case of obviousness. In going from the prior art to the claimed invention, one cannot base obviousness on what a person skilled in the art might try or find obvious to *try – unless there was a clear, evident and articulated rationale and motivation for one of ordinary skill in the art for having done so at the time the invention was made*, but rather must consider what the prior art would have lead a person skilled in the art to *do*.

There is no incentive, teaching or suggestion in the Guenther reference or the McCormick reference to produce the invention now recited in claims 24, 26, 32, 33 and 36. The mere fact that the cited the Guenther reference and the McCormick reference could, with the benefit of hindsight, produce something vaguely similar to the invention does not make the modification obvious, or suggest the desirability of the modification required to arrive at the invention. Indeed, this conclusion is buttressed by the fact that ***many*** elements and limitations are missing in the Guenther reference and the McCormick reference in respect of claims 24, 26, 32, 33 and 36, and as discussed above in detail.

It is well settled that a motivation to combine elements or limitations disclosed in disparate references *must be found from pertinent sources of information*, and that such a motivation does not arise, as here, by merely identifying a collection of disparate piece parts in a combination of references, and then asserting it would have been obvious to take such disparate elements and limitations and add many others thereto to arrive at the presently claimed invention.

There is no suggestion of what direction any experimentation should follow in the Guenther reference or the McCormick reference to obtain the invention recited in claims 24, 26, 32, 33 and 36. Accordingly,

the result effective variables, for example forming a hermetic seal between a lid and a substrate using a bonding agent, and then applying a caulking agent to the bonding agent to improve the hermeticity thereof, are not known to be result effective. Thousands or millions of attempts at variations might be made before arriving at the desired improvement. Thus, to say that it would be obvious to read the Guenther reference and the McCormick reference and somehow arrive at the invention recited in claims 24, 26, 32, 33 and 36 is clearly not the test for obviousness.

The foregoing analysis also makes it clear that there is no basis in the art for modifying the teachings of the Guenther reference and the McCormick reference to arrive at the invention recited in claims 24, 26, 32, 33 and 36. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination, or some other pertinent factual basis supporting such a combination. The Guenther reference ***teaches literally nothing*** regarding the problems associated with forming a hermetic seal, or maintaining the hermeticity thereof, in an integrated circuit package, and instead is directed towards solving problems arising from the breakage or flexure of thin glass substrates in OLED displays. The McCormick reference teaches how to overcome the problems associated with NOT having an hermetic seal in an OED package by providing a dessicant-loaded adhesive to intercept any moisture or vapor that might enter such a package. Thus, there exists no motivation to combine the teachings of the Guenther reference and the McCormick reference, and even if such a motivation existed (and it does not), there would still be at least six elements missing therefrom in respect of claims 24, 26, 32, 33 and 36.

When, as here, the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly does not exist that the claimed subject matter would have been obvious. Thus, the attempt to use the

applicants' own disclosure as a blueprint to reconstruct in hindsight the invention now recited in the claims out of isolated teachings appearing in the prior art is clearly improper.

The results and advantages produced by the invention set forth in claims 24, 26, 32, 33 and 36 as presented herein, and of which the cited Guenther reference and the McCormick reference are devoid, cannot be ignored simply because the claim limitations might be deemed similar to the otherwise barren prior art.

The foregoing analysis also makes it clear that many limitations appearing in claims 24, 26, 32, 33 and 36 as amended herein are simply not present in the Guenther reference and the McCormick reference; the analysis above shows that there are at least six different elements and limitations recited in claims 24, 26, 32, 33 and 36 that are missing from the Guenther and McCormick references, alone or in combination. When evaluating a claim for determining obviousness, *all* limitations of the claim must be evaluated. Under §103, claims 24, 26, 32, 33 and 36 cannot be dissected, each in turn, the various individual elements recited in the claims excised, and then the remaining portions of the mutilated claims declared to be unpatentable. The basic rule of claim interpretation of reading the claims as a whole must be followed. Accordingly, the Guenther reference and the McCormick reference may not properly be used as a basis for rejecting claims 24, 26, 32, 33 and 36 under §103.

Finally, the functions, ways and results provided by the devices and methods disclosed in the Guenther and McCormick references are completely different from those provided by the claimed invention. The device disclosed in the Guenther reference is configured to prevent the breakage or flexure of thin glass substrates in OLED displays and to prevent corrosion of exposed conductors that might result from exposure to the ambient environment. There are no teachings therein respecting appropriate structures or operational parameters for creating redundant or improved hermetic seals in an integrated circuit package. The

devices disclosed in the McCormick reference are configured to protect OEDs from ambient conditions by means of dessicant-loaded adhesives configured to intercept moisture and vapor that might leak into an OED package. Thus, the devices and configurations employed in the Guenther and McCormick references, and the results provided by such devices and configurations, are quite different from those provided by the inventions set forth in claims 24, 26, 32, 33 and 36. Such opposing functions, ways and results establish yet further that the inventions set forth in claims 24, 26, 32, 33 and 36 are not *prima facie* obvious in view of the Guenther and McCormick references.

For all the foregoing reasons and more, the presently claimed invention is not *prima facie* obvious in view of the Guenther and McCormick references.

(2) Claims 25 and 27 are not obvious over the Guenther reference in view of the McCormick and Wang references

Claims 25 and 27 depend from claim 24, and therefore include all the elements and limitations thereof. As shown above in Section VII(D)(1) above, at least six different elements and limitations recited in claim 24 are missing from both the Guenther reference and the McCormick reference.

Comparison of the various elements and limitations recited in claims 25 and 27 to the Wang reference yields similar results (namely, many elements and limitations recited in claims 25 and 27 are missing from the Wang reference). The Wang reference does not disclose ***at least*** the following elements and limitations included in all such claims as they are enumerated in Section VII(B) above:

(a) A hermetically sealed integrated circuit package, comprising *[the Wang reference does not disclose any hermetically sealed device or integrated circuit package]:*

(b) an integrated circuit comprising a substrate having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion *[the Wang reference does not disclose any integrated circuit];*

(c) a hermetic cap comprising a top member and a gasket, the cap being configured to cover the hermetically sealed portion and form a hermetically sealed cavity thereover, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap, the

sidewalls terminating in and being separated by a bottom edge *[the Wang reference does not disclose any hermetically sealed cap]*;

(d) a bonding agent disposed between and engaging the substrate and the bottom edge to form a hermetic seal between the cap and the substrate and thereby hermetically seal the cavity *[the Wang reference does not disclose any hermetic seal]*;

(e) the bonding agent further comprising opposing second inner and second outer sidewalls disposed between the substrate and the gasket, the second inner sidewall being located within the hermetically sealed portion, the second outer sidewall being located outside the hermetically sealed portion, and *[the Wang reference does not disclose any hermetically sealed portion]*

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[the Wang reference does not disclose any caulking agent]*;

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall *[the Wang reference does not disclose any caulking agent in contact with and covering a bonding agent]*;

(h) the caulking agent extending between the substrate and the gasket *[the Wang reference does not disclose any caulking agent extending between a substrate and a gasket]*;

(i) and being configured to seal the cavity *[the Wang reference does not disclose any caulking agent sealing a cavity]*;

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent *[the Wang reference does not disclose any caulking agent improving the hermeticity of a hermetic seal formed by a bonding agent]*.

As discussed above, the Wang reference discloses two different sealing layers, 46I and 46II, which are separated by ribs 52Ia, and which are not in contact with one another. While the housing disclosed and shown in the Wang reference features first and second sealing layers 46I and 46II, the seals are not in contact with one another, are separated from one another by one or more ribs 52I, 52II and 56, and are not disclosed as forming hermetic seals. Indeed, nowhere does the Wang reference employ or disclose the terms "hermetic" or "hermetically." In addition, the Wang reference does not disclose caulk or caulking materials. Instead, the sealing materials disclosed in the Wang reference are limited to "ceramic, polymer, metal or composite" (see, for example, col. 3, lines 63-67 of the Wang reference). There is no discussion or disclosure anywhere in the Wang reference of a caulking agent improving the hermeticity of a seal provided by a bonding agent, or being disposed directly thereover. Is also noteworthy that the complicated housing sealing structure of the Wang reference consumes substantially more volume than that of the presently claimed invention,

where the caulking agent is in direct contact with and overlies one or another, or both, of the sidewalls formed by the bonding agent instead of discrete and separate compartments formed by ribs having sealing layers disposed therewithin.

In view of the discussion above regarding the respective contents of the Guenther, McCormick and Wang references, it will become clear that there is no combination of the disparate elements disclosed in the three references that can produce elements that are missing from both such references, namely elements (a), (b), (f), (g), (h) and (j). In other words, no combination of the various elements disclosed in the Guenther, McCormick and Wang references can produce ***the at least six elements missing therefrom*** with respect to the elements and limitations recited in claims 25 and 27.

The Applicants have discovered that a certain novel combination of packaging, bonding, integrated circuit, sealing and semiconductor elements combined and configured in a certain order are required to produce the beneficial effects of the invention. As demonstrated above, ***many interconnected elements and limitations recited in claims 25 and 27 are neither disclosed nor suggested anywhere in the Guenther, McCormick or Wang references***, and accordingly cannot be *prima facie* obvious.

Merely asserting that "would be obvious to try" the invention by making reference to the adhesive and protection layer of the Guenther reference, the dessicant-loaded adhesive seal of McCormick, and the discrete and separated sealing layers of the Wang reference, while essentially creating other claimed elements out of whole cloth without referring to any specific portions of the cited references to establish a motivation for combining elements or functionality disclosed therein, does not establish a *prima facie* case of obviousness. In going from the prior art to the claimed invention, one cannot base obviousness on what a person skilled in the art might try or find obvious to *try – unless there*

was a clear, evident and articulated rationale and motivation for one of ordinary skill in the art for having done so at the time the invention was made, but rather must consider what the prior art would have lead a person skilled in the art to *do*.

There is no incentive, teaching or suggestion in the Guenther, McCormick or Wang references to produce the inventions recited in claims 25 and 27. The mere fact that the cited Guenther, McCormick and Wang references could, with the benefit of hindsight, produce something vaguely similar to the invention does not make the modification obvious, or suggest the desirability of the modification required to arrive at the invention. Indeed, this conclusion is buttressed by the fact that ***many*** elements and limitations are missing in the Guenther, McCormick and Wang references in respect of claims 25 and 27.

It is well settled that a motivation to combine elements or limitations disclosed in disparate references *must be found from pertinent sources of information*, and that such a motivation does not arise, as here, by merely identifying a collection of disparate piece parts in a combination of references, and then asserting it would have been obvious to take such disparate elements and limitations and add many others thereto to arrive at the presently claimed invention.

There is no suggestion of what direction any experimentation should follow in the Guenther, McCormick or Wang references to obtain the inventions recited in claims 25 and 27. Accordingly, the result effective variables, for example forming a hermetic seal between a lid and a substrate using a bonding agent, and then applying a caulking agent to the bonding agent to improve the hermeticity thereof, are not known to be result effective. Thousands or millions of attempts at variations might be made before arriving at the desired improvement. Thus, to say that it would be obvious to read the Guenther, McCormick

and Wang references and somehow arrive at the inventions recited in claims 25 and 27 is clearly not the test for obviousness.

The foregoing analysis also makes it clear that there is no basis in the art for modifying the teachings of the Guenther, McCormick and Wang references to arrive at the inventions recited in claims 25 and 27. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination, or some other pertinent factual basis supporting such a combination. The Guenther reference ***teaches literally nothing*** regarding the problems associated with forming a hermetic seal, or maintaining the hermeticity thereof, in an integrated circuit package, and instead is directed towards solving problems arising from the breakage or flexure of thin glass substrates in OLED displays. The McCormick reference teaches how to overcome the problems associated with NOT having an hermetic seal in an OED package by providing a dessicant-loaded adhesive to intercept any moisture or vapor that might enter such a package. The Wang reference teaches nothing regarding the problems associated with forming a hermetic seal of any kind, and further teaches away from the invention by requiring the formation of separate adjoining compartments separated by ribs to hold different sealing materials. Thus, there exists no motivation to combine the teachings of the Guenther, McCormick and Wang references, and even if there were such a motivation (and there is not), there would still be at least six elements missing therefrom in respect of claims 25 and 27.

When, as here, the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly does not exist that the claimed subject matter would have been obvious. Thus, the attempt to use the applicants' own disclosure as a blueprint to reconstruct in hindsight the

inventions now recited in claims 25 and 27 out of isolated teachings appearing in the prior art is clearly improper.

The results and advantages produced by the inventions set forth in claims 25 and 27 as presented herein, and of which the cited Guenther, McCormick and Wang references are devoid, cannot be ignored simply because the claim limitations might be deemed similar to the otherwise barren prior art.

The foregoing analysis also makes it clear that many limitations appearing in claims 25 and 27 are simply not present in the Guenther, McCormick and Wang references; the analysis above shows that there are at least six different elements and limitations recited in claims 25 and 27 that are missing from the Guenther, McCormick and Wang references. When evaluating a claim for determining obviousness, *all* limitations of the claim must be evaluated. Under §103, claims 25 and 27 cannot be dissected in turn, the various individual elements recited in the claims excised, and then the remaining portions of the mutilated claims declared to be unpatentable. The basic rule of claim interpretation of reading the claims as a whole must be followed. Accordingly, the Guenther, McCormick and Wang references may not properly be used as a basis for rejecting claims 25 and 27 under §103.

Finally, the functions, ways and results provided by the devices and methods disclosed in the Guenther, McCormick and Wang references are completely different from those provided by the inventions recited in claims 25 and 27. The device disclosed in the Guenther reference is configured to prevent the breakage or flexure of thin glass substrates in OLED displays and to prevent corrosion of exposed conductors that might result from exposure to the ambient environment. There are no teachings therein respecting appropriate structures or operational parameters for creating redundant or improved hermetic seals in an integrated circuit package. The devices disclosed in the McCormick reference are configured to protect OEDs from

ambient conditions by means of dessicant-loaded adhesives configured to intercept moisture and vapor that might leak into an OED package. The devices disclosed in the Wang reference are configured to protect luminary devices from ambient conditions by means of physically separated sealing layers. Thus, the devices and configurations employed in the Guenther, McCormick and Wang references, and the results provided by such devices and configurations, are quite different from those provided by the inventions set forth in claims 25 and 27. Such opposing functions, ways and results establish yet further that the inventions set forth in claims 25 and 27 are not *prima facie* obvious in view of the Guenther, McCormick and Wang references.

For all the foregoing reasons and more, the presently claimed invention is not *prima facie* obvious in view of the Guenther, McCormick and Wang references.

(3) Claim 31 is not obvious over the Guenther reference in view of the McCormick and Goldmann references

Claim 31 depends from claim 24, and therefore includes all the elements and limitations thereof. As shown above in Section VII(D)(1) above, at least six different elements and limitations recited in claim 24 are missing from the Guenther and McCormick references.

Comparison of the various elements and limitations recited in claim 31 to the Goldmann reference yields similar results (namely, many elements and limitations recited in claim 31 are missing from the Goldmann reference). The Goldmann reference does not disclose ***at least*** the following elements and limitations included in all such claims as they are enumerated in Section VII(B) above:

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[the Goldmann reference does not disclose any caulking agent]*;

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall *[the Goldmann reference does not disclose any caulking agent in contact with and covering a bonding agent]*;

(h) the caulking agent extending between the substrate and the gasket *[the Goldmann reference does not disclose any caulking agent extending between a substrate and a gasket]*;

(i) and being configured to seal the cavity *[the Goldmann reference does not disclose any caulking agent sealing a cavity]*;

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent *[the Goldmann reference does not disclose any caulking agent improving the hermeticity of a hermetic seal formed by a bonding agent]*.

In the Goldmann reference, a hermetic seal is provided between chip cover 112 and chip carrier 114, where the seal comprises solder 152, polymeric cushion frame 54, metal cover adhesion frame 142, and lower adhesion frame 132. The vertically stacked arrangement of seal components 142, 152, 132 and 54 means that failure of the seal provided by any one of such components will result in a compromised and non-hermetic seal. That is, none of the seal components disclosed in the Goldmann reference improves the hermeticity of any of the other seal components disclosed therein. The Goldmann reference certainly contains no disclosure of a caulking agent that acts to improve the hermeticity of any of the seal components disclosed therein.

In view of the above discussion regarding the respective contents of the Guenther, McCormick and Goldmann references, it will become clear that there is no combination of the disparate elements disclosed in the three references that can produce elements that are missing from such references, namely elements (f), (g), (h) and (j). In other words, no combination of the various elements disclosed in the Guenther, McCormick and Goldmann references can produce ***the at least four elements missing therefrom*** with respect to the elements and limitations recited in claim 31.

The Applicants have discovered that a certain novel combination of packaging, bonding, integrated circuit, sealing and semiconductor

elements combined and configured in a certain order are required to produce the beneficial effects of the invention. As demonstrated above, ***many interconnected elements and limitations recited in claim 31 are neither disclosed nor suggested anywhere in the Guenther, McCormick and Goldmann references***, and accordingly cannot be *prima facie* obvious.

Merely asserting that "would be obvious to try" the invention by making reference to the adhesive and protection layer of the Guenther reference, the dessicant-loaded adhesive seal of McCormick, and the vertically stacked sealing layers of the Goldmann reference, while essentially creating other claimed elements out of whole cloth without referring to any specific portions of the cited references to establish a motivation for combining elements or functionality disclosed therein, would not establish a *prima facie* case of obviousness. In going from the prior art to the claimed invention, one cannot base obviousness on what a person skilled in the art might try or find obvious to try – unless there was a clear, evident and articulated rationale and motivation for one of ordinary skill in the art for having done so at the time the invention was made, but rather must consider what the prior art would have lead a person skilled in the art to *do*.

There is no incentive, teaching or suggestion in the Guenther, McCormick or Goldmann references to produce the invention recited in claim 31. The mere fact that the cited the Guenther, McCormick and Goldmann references could, with the benefit of hindsight, produce something vaguely similar to the invention of claim 31 does not make the modification obvious, or suggest the desirability of the modification required to arrive at the invention. Indeed, this conclusion is buttressed by the fact that ***many*** elements and limitations are missing in the Guenther, McCormick or Goldmann references in respect of claim 31, and as discussed above in detail.

It is well settled that a motivation to combine elements or limitations disclosed in disparate references *must be found from pertinent sources of information,* and that such a motivation does not arise, as here, by merely identifying a collection of disparate piece parts in a combination of references, and then asserting it would have been obvious to take such disparate elements and limitations and add many others thereto to arrive at the claimed invention.

There is no suggestion of what direction any experimentation should follow in the Guenther, McCormick and Goldmann references to obtain the invention recited in claim 31. Accordingly, the result effective variables, for example forming a hermetic seal between a lid and a substrate using a bonding agent, and then applying a caulking agent to the bonding agent to improve the hermeticity thereof, are not known to be result effective. Thousands or millions of attempts at variations might be made before arriving at the desired improvement. Thus, to say that it would be obvious to read the Guenther, McCormick or Goldmann references and somehow arrive at the invention recited in claim 31 would clearly not be the test for obviousness.

The foregoing analysis also makes it clear that there is no basis in the art for modifying the teachings of the Guenther, McCormick or Goldmann references to arrive at the invention recited in claim 31. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination, or some other pertinent factual basis supporting such a combination., or some other pertinent factual basis supporting such a combination. The Guenther reference ***teaches literally nothing*** regarding the problems associated with forming a hermetic seal, or maintaining the hermeticity thereof, in an integrated circuit package, and instead is directed towards solving problems arising from the breakage or flexure of thin glass substrates in OLED displays. The McCormick reference teaches how to

overcome the problems associated with NOT having an hermetic seal in an OED package by providing a dessicant-loaded adhesive to intercept any moisture or vapor that might enter such a package. The Goldmann reference teaches nothing regarding the problems associated with forming a redundant or enhanced hermetic seal of any kind, and further teaches away from the invention by requiring the formation of vertically stacked sealing members. Thus, there exists no motivation to combine the teachings of the Guenther, McCormick and Goldmann references, and even if there were such a motivation (and there is not), there would still be at least four elements missing therefrom in respect of claim 31.

When, as here, the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly does not exist that the claimed subject matter would have been obvious. Thus, the attempt to use the applicants' own disclosure as a blueprint to reconstruct in hindsight the invention recited in claim 31out of isolated teachings appearing in the prior art is clearly improper.

The results and advantages produced by the invention set forth in claim 31, and of which the cited Guenther, McCormick and Goldmann references are devoid, cannot be ignored simply because the claim limitations might be deemed similar to the otherwise barren prior art.

The foregoing analysis also makes it clear that many limitations appearing in claim 31 are simply not present in the Guenther, McCormick and Goldmann references; the analysis above shows that there are at least four different elements and limitations recited in claim 31 that are missing from the Guenther, McCormick and Goldmann references. When evaluating a claim for determining obviousness, *all* limitations of the claim must be evaluated. Under §103, claim 31 cannot be dissected, the various individual elements recited in the claim excised, and then the remaining portions of the mutilated claim declared to be unpatentable. The basic rule of claim interpretation of reading the

claim as a whole must be followed. Accordingly, the Guenther, McCormick and Goldmann references may not properly be used as a basis for rejecting claim 31 under §103.

Finally, the functions, ways and results provided by the devices and methods disclosed in the Guenther, McCormick and Goldmann references are completely different from those provided by the claimed invention. The device disclosed in the Guenther reference is configured to prevent the breakage or flexure of thin glass substrates in OLED displays and to prevent corrosion of exposed conductors that might result from exposure to the ambient environment. There are no teachings therein respecting appropriate structures or operational parameters for creating redundant or improved hermetic seals in an integrated circuit package. The devices disclosed in the McCormick reference are configured to protect OEDs from ambient conditions by means of dessicant-loaded adhesives configured to intercept moisture and vapor that might leak into an OED package. The devices disclosed in the Goldmann reference are configured to provide seals by means of vertically stacked seal members which provide no redundancy or seal enhancement respecting other seal members. Thus, the devices and configurations employed in the Guenther, McCormick and Goldmann references, and the results provided by such devices and configurations, are quite different from those provided by the invention set forth in claim 31. Such opposing functions, ways and results establish yet further that the invention set forth in claim 31 is not *prima facie* obvious in view of the Guenther, McCormick and Goldmann references.

For all the foregoing reasons and more, the presently claimed invention is not *prima facie* obvious in view of the Guenther, McCormick and Goldmann references.

(4) Claim 34 is not obvious over the Guenther reference in view of the McCormick and the APA

Claim 34 depends from claim 24, and therefore includes all the elements and limitations thereof. As shown above in Section VII(D)(1) above, at least six different elements and limitations recited in claim 24 are missing from the Guenther and McCormick references.

Comparison of the various elements and limitations recited in claim 34 to the Applicant's Prior Art ("APA") yields similar results (namely, many elements and limitations recited in claim 34 are missing from the APA). The APA does not disclose ***at least*** the following elements and limitations included in claim 34 as they are enumerated in Section VII(B) above:

(f) a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall *[the APA does not disclose any caulking agent]*;

(g) such that the caulking agent extends between and covers substantially all of and is directly in contact with at least one of the second inner sidewall and the second outer sidewall *[the APA does not disclose any caulking agent in contact with and covering a bonding agent]*;

(h) the caulking agent extending between the substrate and the gasket *[the APA does not disclose any caulking agent extending between a substrate and a gasket]*;

(i) and being configured to seal the cavity *[the APA does not disclose any caulking agent sealing a cavity]*;

(j) and improve the hermeticity of the hermetic seal formed by the bonding agent *[the APA does not disclose any caulking agent improving the hermeticity of a hermetic seal formed by a bonding agent].*

Perusal of the APA shows that it merely discloses the state of the art regarding hermetic seal technology for integrated circuits and integrated circuit substrates. ***Nowhere does the APA disclose a caulking agent,*** let alone a caulking agent applied to a bonding agent that improves the hermeticity of the seal provided by the bonding agent. Instead, the APA discloses a conventional hermetic seal provided by a bonding agent alone. As discussed above, the APA cited by the Examiner consists of Fig. 2 and paragraph 3 of the present patent application.

In view of the above discussion regarding the respective contents of the Guenther, McCormick and APA references, it will become clear that there is no combination of the disparate elements disclosed in the three references that can produce elements that are missing from such references, namely elements (f), (g), (h), (i) and (j). In other words, no combination of the various elements disclosed in the Guenther, McCormick and APA references can produce ***the at least five elements missing therefrom*** with respect to the elements and limitations recited in claim 34.

The Applicants have discovered that a certain novel combination of packaging, bonding, integrated circuit, sealing and semiconductor elements combined and configured in a certain order are required to produce the beneficial effects of the invention. As demonstrated above, ***many interconnected elements and limitations recited in claim 34 are neither disclosed nor suggested anywhere in the Guenther, McCormick and APA references***, and accordingly cannot be *prima facie* obvious.

Merely asserting that "would be obvious to try" the invention by making reference to the adhesive and protection layer of the Guenther reference, the dessicant-loaded adhesive seal of McCormick, and the conventional single bonding agent of the APA, while essentially creating other claimed elements out of whole cloth without referring to any specific portions of the cited references to establish a motivation for combining elements or functionality disclosed therein, would not establish a *prima facie* case of obviousness. In going from the prior art to the claimed invention, one cannot base obviousness on what a person skilled in the art might try or find obvious to try – unless there was a clear, evident and articulated rationale and motivation for one of ordinary skill in the art for having done so at the time the invention was made, but rather must consider what the prior art would have lead a person skilled in the art to *do*.

There is no incentive, teaching or suggestion in the Guenther, McCormick or APA references to produce the invention recited in claim 34. The mere fact that the cited the Guenther, McCormick and APA references could, with the benefit of hindsight, produce something vaguely similar to the invention of claim 31 does not make the modification obvious, or suggest the desirability of the modification required to arrive at the invention. Indeed, this conclusion is buttressed by the fact that ***many*** elements and limitations are missing in the Guenther, McCormick or APA references in respect of claim 34, and as discussed above in detail.

It is well settled that a motivation to combine elements or limitations disclosed in disparate references *must be found from pertinent sources of information*, and that such a motivation does not arise, as here, by merely identifying a collection of disparate piece parts in a combination of references, and then asserting it would have been obvious to take such disparate elements and limitations and add many others thereto to arrive at the claimed invention.

There is no suggestion of what direction any experimentation should follow in the Guenther, McCormick and APA references to obtain the invention recited in claim 34. Accordingly, the result effective variables, for example forming a hermetic seal between a lid and a substrate using a bonding agent, and then applying a caulking agent to the bonding agent to improve the hermeticity thereof, are not known to be result effective. Thousands or millions of attempts at variations might be made before arriving at the desired improvement. Thus, to say that it would be obvious to read the Guenther, McCormick and APA references and somehow arrive at the invention recited in claim 34 is clearly not the test for obviousness.

The foregoing analysis also makes it clear that there is no basis in the art for modifying the teachings of the Guenther, McCormick or APA references to arrive at the invention recited in claim 34. Obviousness cannot be established by combining or modifying the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination, or some other pertinent factual basis supporting such a combination., or some other pertinent factual basis supporting such a combination. The Guenther reference ***teaches literally nothing*** regarding the problems associated with forming a hermetic seal, or maintaining the hermeticity thereof, in an integrated circuit package, and instead is directed towards solving problems arising from the breakage or flexure of thin glass substrates in OLED displays. The McCormick reference teaches how to overcome the problems associated with NOT having an hermetic seal in an OED package by providing a dessicant-loaded adhesive to intercept any moisture or vapor that might enter such a package. . The APA teaches nothing regarding solutions to problems associated with forming a redundant or enhanced hermetic seal of any kind. Thus, there exists no motivation to combine the teachings of the Guenther, McCormick and APA references, and even if there were such a motivation (and there is

not), there would still be at least five elements missing therefrom in respect of claim 34.

When, as here, the prior art itself provides no apparent reason for one of ordinary skill in the art to make a modification or to combine references, an argument clearly does not exist that the claimed subject matter would have been obvious. Thus, the attempt to use the applicants' own disclosure as a blueprint to reconstruct in hindsight the invention recited in claim 34 out of isolated teachings appearing in the prior art is clearly improper.

The results and advantages produced by the invention set forth in claim 34, and of which the cited Guenther, McCormick and APA references are devoid, cannot be ignored simply because the claim limitations might be deemed similar to the otherwise barren prior art.

The foregoing analysis also makes it clear that many limitations appearing in claim 34 are simply not present in the Guenther, McCormick and APA references; the analysis above shows that there are at least five different elements and limitations recited in claim 34 that are missing from the Guenther, McCormick and APA references. When evaluating a claim for determining obviousness, *all* limitations of the claim must be evaluated. Under §103, claim 34 cannot be dissected, the various individual elements recited in the claim excised, and then the remaining portions of the mutilated claim declared to be unpatentable. The basic rule of claim interpretation of reading the claim as a whole must be followed. Accordingly, the Guenther, McCormick and APA references may not properly be used as a basis for rejecting claim 34 under §103.

Finally, the functions, ways and results provided by the devices and methods disclosed in the Guenther, McCormick and APA references are completely different from those provided by the claimed invention. The device disclosed in the Guenther reference is configured to prevent the breakage or flexure of thin glass substrates in OLED displays and to

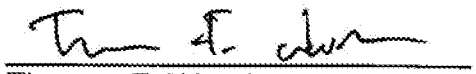
prevent corrosion of exposed conductors that might result from exposure to the ambient environment. There are no teachings therein respecting appropriate structures or operational parameters for creating redundant or improved hermetic seals in an integrated circuit package. The devices disclosed in the McCormick reference are configured to protect OEDs from ambient conditions by means of dessicant-loaded adhesives configured to intercept moisture and vapor that might leak into an OED package. The devices disclosed in the APA are configured to provide conventional single bonding agent seals which provide no redundancy or seal enhancement respecting other seal members. Thus, the devices and configurations employed in the Guenther, McCormick and APA references, and the results provided by such devices and configurations, are quite different from those provided by the invention set forth in claim 34. Such opposing functions, ways and results establish yet further that the invention set forth in claim 34 is not *prima facie* obvious in view of the Guenther, McCormick and APA references.

For all the foregoing reasons and more, the presently claimed invention is not *prima facie* obvious in view of the Guenther, McCormick and APA references.

VIII. Summary

Claims 24-27 and 31-36 are the subject of this Appeal, and are believed to be in condition for allowance. Review and allowance of the appealed claims as presented herein is requested. The Board is respectfully requested to contact the undersigned by telephone or e-mail with any questions or comments they may have.

Respectfully submitted,
R. Shane Fazzio
By his attorney



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Claims Appendix

24. A hermetically sealed integrated circuit package, comprising:

an integrated circuit comprising a substrate having an upper surface, a perimeter being disposed upon the upper surface and defining a hermetically sealed portion therewithin, at least one circuit element being disposed within the hermetically sealed portion;

a hermetic cap comprising a top member and a gasket, the cap being configured to cover the hermetically sealed portion and form a hermetically sealed cavity thereover, the gasket comprising opposing first inner and first outer vertical sidewalls depending downwardly from the cap, the sidewalls terminating in and being separated by a bottom edge;

a bonding agent disposed between and engaging the substrate and the bottom edge to form a hermetic seal between the cap and the substrate and thereby hermetically seal the cavity, the bonding agent further comprising opposing second inner and second outer sidewalls disposed between the substrate and the gasket, the second inner sidewall being located within the hermetically sealed portion, the second outer sidewall being located outside the hermetically sealed portion, and

a caulking agent disposed along and engaging at least one of the second inner sidewall and the second outer sidewall such that the caulking agent extends between and covers substantially all of and is in direct contact with at least one of the second inner sidewall and the second outer sidewall, the caulking agent extending between the substrate and the gasket and being configured to seal the cavity and improve the hermeticity of the hermetic seal formed by the bonding agent.

25. The hermetically sealed integrated circuit package of claim 24, wherein the caulking agent is disposed along substantially all of the second inner sidewall.

26. The hermetically sealed integrated circuit package of claim 24, wherein the caulking agent is disposed along substantially all of the second outer sidewall.

27. The hermetically sealed integrated circuit package of claim 24, wherein the caulking agent is disposed along substantially all of the second outer sidewall and the second inner sidewall.

31. The hermetically sealed integrated circuit package of claim 24, wherein the caulking agent comprises multiple layers of caulking material.

32. The hermetically sealed integrated circuit package of claim 24, wherein the bonding agent comprises gold.

33. The hermetically sealed integrated circuit package of claim 24, wherein the caulking agent comprises at least one of an amorphous fluorocarbon polymer, a polyimide material, and a benzocyclobutene-based material.

34. The hermetically sealed integrated circuit package of claim 24, wherein a thickness of the gasket between the first inner sidewall and the first outer sidewall ranges between about 1 micron and about 10 microns.

35. The hermetically sealed integrated circuit package of claim 24, wherein the at least one circuit element comprises at least one of a resonator, a transistor and a connector.

36. The hermetically sealed integrated circuit package of claim 24, wherein the substrate comprises silicon.

Evidence Appendix

None.

U.S. Patent Appln. Ser. No. 10/807,417 entitled "Microcap Wafer Bonding Apparatus " to Fazzio; Avago Technologies Attorney Docket No. 10030899-1; Woods Patent Law Docket No. P AVG 188.

Related Proceedings Appendix

None.